Unicondylar Knee Arthroplasty in the Inpatient vs Outpatient Setting: Impact on Process Time, Quality Outcomes, and Patient Satisfaction

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UNICONDYLAR KNEE ARTHROPLASTY IN THE INPATIENT VS OUTPATIENT SETTING: IMPACT ON PROCESS TIME, QUALITY OUTCOMES, AND PATIENT SATISFACTION

by

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ABSTRACT

The implications of rising healthcare expenditures are of great concern nationally and internationally. Performing procedures in the outpatient setting can be one solution to this crisis. However, there is a lack of research on systematic approaches for transitioning procedures to the outpatient setting. Unicondylar knee arthroplasty (UKA) presents an opportunity, as it is already in the early stages of transitioning to the outpatient setting. The key step in facilitating an effective transition to the outpatient setting is comparing outpatient UKAs with inpatient UKAs with a focus on process time, quality outcomes, and patient satisfaction. This study retrospectively compares 400 UKA patients in the outpatient setting with 675 UKA patients in the inpatient setting. The primary analytical tools for this study are Ordinary Least Squares Regression, Logistic Regression, and Ordinal Regression adjusting for comorbidity, social history, demographics, and surgery related characteristics. Outpatient UKAs outperformed inpatient UKAs across 11 of 18 variables analyzed. Process Time will be less for outpatient UKAs in all phases with the exception of Surgery Breakdown Time. The risk-adjusted quality outcomes of UKAs in the outpatient setting were better across Non-Surgery Related Complications, Follow-Up Pain, and Follow-Up Functional Range of Motion Limitation. Patient Satisfaction was higher for outpatient UKAs. There was a lack of consistent and appropriate information to conduct a substantial statistical analysis of the costs. These findings point towards outpatient UKAs being a viable option in the future. This research serves as a platform to launch a system-wide effort of transitioning procedures to the outpatient setting across different specialties.

Keywords: Outpatient Versus Inpatient, Transitioning to Outpatient-Centered Care, Unicompartmental Knee Arthroplasty, Partial Knee Replacement, Ambulatory Surgery

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CHAPTER ONE: INTRODUCTION

Background

Despite concerted efforts to decrease costs, healthcare expenditures continue to rise from their already high levels (Kepros & Opreanu, 2009). One solution, cost containment, has attempted to reduce an inpatient's length of stay. This option has been made possible, in part, due to minimally invasive medical procedures, which require decreased process time, fewer days in the hospital, and less recovery time. Another cost containment strategy, made possible by advances in medical procedures, has been to perform surgeries in the outpatient setting so that patients are rarely admitted to the hospital and are discharged to their homes for the entirety of their recovery (Krywulak, Mohtadi, Russell, & Sasyniuk, 2005).

History of the Transition to the Outpatient Setting

Hospitals started to transition procedures to the outpatient setting based on a number of factors. The initial movements from inpatient to outpatient began after the Tax Equity and Fiscal Responsibility Act (TEFRA) of 1982 (Jordan, 1983). The most significant change was the transition from a fee-for-service (FFS) based system of payments to a Prospective Payment System (PPS). Instead of after-the-fact calculations for reimbursements, all Medicare inpatient services payments became predetermined and based on services associated with the patient's diagnoses (Balotsky, 2005). To refine the reimbursement relationships between providers and payers based on the resource costs per-case for a specific patient treatment group, TEFRA introduced Diagnosis Related Groups (DRGs) as a way to group patients for the PPS (Preston, Chua, & Neu 1997).

Diagnosis Related Groups (DRGs) were used to reimburse inpatient hospital services. DRG reimbursements are based on the diagnosis rather than the actual charges the patients have incurred from services provided. DRGs were a newer method meant to operate in conjunction with grouping patients based on the average costs in all hospitals for all patients in that group (Shwartz & Lenard, 1994). Hospitals were paid a set amount per DRG and needed to find a way to be profitable, so they moved more procedures to the outpatient setting, where they could continue to bill for services.

In the 1980's, Congress passed legislation that mandated that Ambulatory Payment Classification (APC) should be used to pay negotiated fixed rates to hospitals (Contino, 2000). APC was created both as a cost containment measure and as a way to counteract the shift that occurred to the outpatient setting when DRGs were created. APC is a prospective payment system, but it is specifically related to the facility costs of outpatient care. In this method, service codes are classified by their reimbursement method, which determine how the service, procedure, or item is paid creating a hybrid between PPS and DRG based payment systems (Averill & Goldfield, 1993; Casto & Forrestal, 2013).

Transitioning procedures to the outpatient setting was first introduced by hospitals with the creation of outpatient hospital departments (Welsh, 1995). From the onset, hospitals were resistant to the idea of transitioning their services into the outpatient setting due to negative impacts they perceived would occur to their bottom line such as the cannibalization of services and revenue. However, hospitals made decisions to move certain procedures to the outpatient setting based mainly around a motive for profit and reducing costs. Hospitals were able lower their costs and still charge significant amounts, which allowed for outpatient profits to exceed inpatient profits. The hospitals seized on these gaps and created outpatient services mainly based around general outpatient services, with some outpatient surgical procedures, in addition to their already-thriving inpatient services (Welsh, 1995). However, the initial process did not use a systematic nor well-calculated approach to transitioning inpatient procedures to the outpatient setting. Although there were cost savings when hospitals chose to transition their services to the outpatient setting, their profits nevertheless started diminishing. The transition of procedures to outpatient settings was therefore hampered as profits decreased, even with the cost savings of outpatient services. Moreover, there have been limited wide-scale and multi-variable analyses that studied the ramifications to the patient of transitioning surgeries to the outpatient setting, since profits, rather than the consequences of the transition itself, were the main priority

(Berger, Kusuma, Sanders, Thill, & Sporer, 2009; Jamali, Scott, Rubash, & Freiberg, 2009; Welsh, 1995).

Process Time

The process time of surgeries has not been widely compared between the outpatient and inpatient setting (Jamali et al., 2009). Process time can be measured by total throughput time, which is the calculated time from entry into the pre-surgical unit until discharge from the post-anesthesia recovery ward. The process time of a surgical procedure has an impact on the costs incurred by the facility because of shortened overall time in the pre-surgical ward, operating room, and the post-anesthesia recovery ward (Munnich & Parente, 2014). There is also less risk of exposure to facility-borne infections as patients spend less time in the facility.

Quality Outcomes

Another important element is whether or not outpatient procedures provide comparable or improved quality outcomes. Under the Tax Relief and Health Care Act of 2006, the Hospital Outpatient Quality Reporting Program (Hospital OQR) was created to incorporate annual financial incentives for reporting outpatient quality outcomes (Hospital Outpatient Quality Reporting Program, n.d.). Evidence exists through such reporting programs, that the quality of outpatient procedures is actually better than the quality of the same procedures in the inpatient setting. Outpatient administration of pharmaceuticals, such as Nesiritide to treat congestive heart failure, has been found to lead to improved quality outcomes, as shown through the reduction of symptoms, the reduction of hospitalizations, and the reduction of mortality (Josephson & Barnett, 2004). In a German study, transitioning general surgeries (i.e. appendix and gallbladder removals) to the outpatient setting decreased infection rates, led to earlier return to work, and lowered medication use for patients (Haack, 2010). Furthermore, for patients and families, outpatient chemotherapy and autologous stem cell transplantation has high quality and is effective compared with their inpatient counterparts (Summers, Dawe, & Stewart, 2000).

Patient Satisfaction

Patient satisfaction came to the forefront when the Centers for Medicare & Medicaid Services (CMS) created the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). HCAHPS is a database that collects standardized survey data from patients after their discharge from a facility. Patient perceptions of facilities are collected and made public for facility-to-facility comparisons of patient perceptions and quality outcomes (HCAHPS, n.d.). Facilities hold patient satisfaction in high regard because there are financial incentives to higher patient satisfaction. Facilities were financially incentivized to improve patient satisfaction through additional Medicare payments and Accountable Care Organization incentives. The Patient Protection and Affordable Care Act (ACA) in 2013 made reimbursements based on the patient perception from HCAPHS and quality data (Read the Law, n.d.). These standardized measures of patient satisfaction are being utilized to reward facilities that have high patient satisfaction and correlate that to high quality outcomes. One example of this is the Health Information Technology for Economic and Clinical Health Act (HITECH Act).

The HITECH Act, created by the American Recovery and Reinvestment Act of 2009, incentivized healthcare providers financially to adopt and use electronic medical records systems for meaningful use (EHR Incentive Programs, n.d.). These governmental financial incentives began as percentage increases in the first years of compliance. However, when these systems are not put into place, facilities are penalized with lower reimbursements each year of non-compliance. A key result of implementing meaningful use compliant systems is that patient satisfaction data can be more effectively measured and assessed in a standard way and in the context of other clinical parameters. The hope is that such data can be used to guide future improvements across the healthcare system as well as to encourage healthcare providers to adopt such changes. If facilities do not maintain high levels of patient satisfaction, patients through word of mouth can influence providers into shifting their services to different facilities that have higher patient satisfaction (Westbrook, Babakus, & Grant, 2014).

Studies have also found that patient satisfaction with regards to nursing care is higher in the outpatient setting as compared with the inpatient setting (Gamotis, Dearmon, Doolittle, & Price, 1988; Haack, 2010). A study in Germany found patient's responsiveness (a measure of patient satisfaction) to mental healthcare, was higher in the outpatient setting (Bramesfeld, Wedegärtner, Elgeti, & Bisson, 2007). Furthermore, for orthopedic procedures, patient satisfaction was higher for outpatient ACL reconstruction surgery as compared with inpatient ACL reconstruction surgery (Krywulak, Mohtadi, Russell, & Sasyniuk, 2005). Browne and colleagues (2008) found that in the United Kingdom, outpatient hip replacement had higher quality of life scores as compared with the same inpatient procedure (Browne et al., 2008).

Combined Approach

In some cases, transitioning procedures to the outpatient setting did not improve quality outcomes and patient satisfaction to a statistically significant degree. For example, in the United Kingdom, hernia repair performed in the outpatient setting did not show statistically significant differences in functional status and quality of life as compared with the inpatient setting (Browne et al., 2008). Transitioning to outpatient laparoscopic cholecystectomy showed comparable or improved quality outcomes, but not to a statistically significant degree, however outpatient cholecystectomy had less costs (Paquette, Smink, & Finlayson, 2008). Although transitioning anterior cervical dissection and fusion to the outpatient setting showed no statistical difference from the inpatient setting, the complication rates were lower in the outpatient setting (Stieber, Brown, Donald, & Cohen, 2005).

Costs

Originally, Gross Charges, Direct Costs, and Revenue were to be analyzed with the other variables. However, there was a lack of patient specific cost data to conduct a substantial statistical analysis of the cost variables. This will be discussed further in the Chapter 5 Discussion, Future Research, and Limitations sections.

Unicondylar Knee Arthroplasty in the Outpatient Setting

Unicondylar knee arthroplasty (UKA) is a procedure that is moving from the inpatient to the outpatient setting. Unicondylar knee arthroplasty is also known as unicompartmental knee arthroplasty or partial knee replacement (Partial knee replacement, 2008). UKA was first introduced in the 1960s in the United Kingdom as a departure from the traditional total knee arthroplasty, which is also known as total knee replacement (Borus & Thornhill, 2008; Jamali, Scott, Rubash, & Freiberg, 2009). It was a procedure based on a patient-centered care model, since medical professionals operated with the opinion to only do what was necessary rather than wasting resources with a total knee arthroplasty. The Agency for Healthcare Research and Quality estimates that, by 2030, the number of knee arthroplasties annually in the United States will increase by 673% to 3.48 million (Kurtz, Ong, Lau, Mowat, & Halpern, 2007).

Recently, a small group of physicians began performing UKAs in the outpatient setting. In early 2009, the Centers for Medicare and Medicaid Services (CMS) added UKA to the list of procedures allowed in the outpatient setting (Centers for Medicare & Medicaid Services, n.d.). With this change in policy, physicians are now freely able to determine, based on patient-centered principles, at which setting UKAs will be performed. Since the vast number of UKAs are still performed in the inpatient setting, comparing outpatient and inpatient UKAs provides a unique opportunity to study the procedure's transition to the outpatient setting (Borus & Thornhill, 2008; Jamali, Scott, Rubash, & Freiberg, 2009).

Potential Benefits of Outpatient UKAs

Performing UKAs in the outpatient setting presents many potential benefits. One of the most appealing factors that patients experience from outpatient UKAs is that they are discharged directly back home the same day as the surgery, thus eliminating hospital stay (Berger et al., 2009; Jamali et al., 2009). Because patients are not forced to stay in an environment that is uncomfortable and unfamiliar, they can quickly begin recovery at home with home health specialists. Additionally, families have the opportunity to be actively involved in the patient's care, which can further increase the patient's comfort.

Benefits also extend to the physician and nursing staff. On UKA surgery days, having specially trained staff is essential and decreases the process time of UKAs. Rather than general hospital surgery training, the specialized training of the staff is based on both the physician's and the specific procedure's requirements. Specialized training extends to nursing and physical therapy services that are packaged with outpatient UKAs as home health services. On the days of surgery, only patients undergoing similar procedures are treated, thus reducing chances of cross contamination from other surgeries. Cross contamination can occur from gastrointestinal surgeries dealing with removing infected tissue that could spread to bone in orthopedic surgeries, which are much more vulnerable to infection (Jamali et al., 2009).

Another benefit is to the outpatient facilities themselves, since they can reduce overhead (Larsen, Hansen, Søballe, & Kehlet, 2012). UKA patients only pay for the services that they receive, so they do not subsidize the costs incurred by other specialties that conduct their surgeries in the same location. All of the surgery team members assisting in the UKA surgery will be focusing on this specific procedure, thus reducing the costs of staffing (Jamali et al., 2009). Additionally, because many of the physicians who perform procedures in the outpatient setting have a personal financial stake in these facilities, there is a heightened incentive to control costs while reducing process time, increasing quality outcomes, and improving patient satisfaction (Borus & Thornhill, 2008). Because UKAs reduce process time and eliminate the need for a hospital stay, costs can be greatly reduced (Berger et al., 2009). Furthermore, the full resources of a hospital are not in use for a specific set of recovery protocols (Borus & Thornhill, 2008). These recovery protocols are altered so that the home of a patient takes the place of the inpatient recovery ward. Indeed, constant monitoring by nursing staff is not necessary for patients discharged to their homes. Instead, patients' caregivers fill the gap of care in between the visits from nurses and physical therapists, who schedule home visits to patients based on a very specific protocol for pain management and recovery created in coordination with their surgeon. Caregivers are even encouraged to participate and learn from these home health specialists, taking an active role in facilitating patient recovery, comfort, motivation, and pain management. Overall, only resources necessary to the specific procedure are incurred, with no facility fees required (Borus & Thornhill, 2008).

Many facets of outpatient UKAs directly and indirectly impact quality outcomes and patient satisfaction. Reducing the process time and discharging patients to their homes after the UKA further reduces the amount of time one is directly exposed to different facility-borne infections (Jamali et al., 2009). This also extends to the patients' caregivers, since they could then transfer these illnesses to the patients under their care. Thus, the patients avoid the hospital altogether and can begin their return to normalcy more quickly than if they were admitted to the hospital (Berger et al., 2009). Additionally, since patients are discharged to their homes, they are in familiar surroundings with caregivers they know, which reduces risks of falling and increases emotional support throughout the recovery process, thus increasing the overall quality of life (Borus & Thornhill, 2008; Larsen et al., 2012). Further, there is reduced potential for deep vein thrombosis because patients must meet certain higher and more vigorous activity levels and movement ranges during each post-operative home visit from nurses and physical therapists (Jamali et al., 2009). UKA continues to be refined in the outpatient setting: reducing process time, pain levels, and recovery times, while increasing functionality. These reductions lead to increasing quality outcomes and patient satisfaction through improvements in anesthesia, pain control, and implant quality and customization.

If UKAs transition to the outpatient setting, a focus can be placed on increasing quality and controlling costs, which would free resources on both the provider and payer sides of the system (Berger et al., 2009). Furthermore, providers would have the ability to grant more quality-focused care to more individuals at cheaper rates, which would, in-turn, allow more individuals to have the access to the UKAs that they need (Larsen et al., 2012). Additionally, payers would have the ability to provide increased coverage and reimbursements to individuals undergoing UKAs and other procedures.

UKAs have also allowed for technological advancements in the medical industry. For instance, identifying where the mechanical axis comes through the knee as well as identifying if the ligaments are compromised and deteriorated is essential because both of these factors impact the bones. In order to gather these readings, specific X-Ray views utilized by Dr. J. Mandume Kerina for this particular surgery. The first X-Ray view is the posterior-anterior view, which is the back to front view of the knee while the patient is standing. The second X-Ray view is the lateral view, which is the side view where most pain occurs when the bone is compressed and stressed. The third X-Ray view is the sunrise/merchant view, which shows the compartment behind the knee. The last X-Ray view is the valgus/varus stress view, which is the most important view because it forces the knee into the opposite position and shows what the ligaments on the sides are doing. These views also help differentiate between hereditary inflammatory arthritis, for pain in multiple joints, and degenerative arthritis, for pain in one joint.

Potential Concerns of Outpatient UKAs

In order to perform UKAs in the outpatient setting, facilities and physicians will need to develop post-operative and facilities management. An essential component to post-operative management is pain management. Without refined protocols and techniques, it can be difficult to control the patient's pain outside of the hospital setting (Berger et al., 2009). Facilities must upgrade their equipment, surgical suites, and train staff to adopt the specific operative standards that are required in the outpatient setting (Larsen et al., 2012). Capital investments and extensive training of clinicians will be required to maintain a high standard of care, both within the outpatient facilities and inside the patient's home after patients are released (Borus & Thornhill, 2008). Furthermore, there are potential costs in outpatient UKAs related to training the highly specialized staff and clinicians involved both during the operation and post-operatively (Jamali et al., 2009).

There may also be negative impacts to the healthcare system with the transition to outpatient

UKAs. The investment necessary to transition UKAs to the outpatient setting, will take upfront capital investments, training, and continuous maintenance of equipment (Jamali et al., 2009). The potential cost-savings of transitioning UKAs to the outpatient setting will be initially offset by the cost of capital investments to upgrade the facilities (Borus & Thornhill, 2008). Specific protocols exist to conduct UKAs correctly, and many facilities do not have the higher-level and advanced ventilation and instruments necessary to perform this procedure. These capital costs must be incurred before the transition to outpatient UKA is complete. Hospitals, physicians, and investors will either have to transfer funds to develop new facilities or upgrade existing systems. These costs require transfer of dollars into the building and development of facilities rather than the building up of current inpatient care systems. The cost transfer could impact quality outcomes and patient satisfaction if too many resources are dedicated to transitioning UKAs to the outpatient setting (Jamali et al., 2009).

Additionally, potential cost savings cause a threat to the status quo of inpatient networks (Jamali et al., 2009). Since UKAs are still mostly performed in the inpatient setting, these cost-saving incentives to providers, payers, and patients alike disrupt the flow of resources to these facilities. Clinicians being consulted will no longer be able to see the patients and charge for these inpatient visits. Although payers, such as Medicare, generally reimburse hospitals a set amount per surgery, many hospitals still account for each and every item used, and cost shift overhead throughout their services. Performing UKAs in the outpatient setting poses a threat to the status quo for hospitals and influential healthcare systems, since physicians will have the ability to perform UKAs where they could have a personal financial stake in the outpatient facility (Welsh, 1995).

There are also potentially negative impacts on quality outcomes and patient satisfaction with outpatient UKAs. For instance, some patients desire the inpatient setting where they can be under 24-hour monitoring by clinicians in a controlled environment after the surgery has been performed (Summers, Dawe, & Stewart, 2000). For patients with the inpatient-centered perception, outpatient UKAs could lower their perceived satisfaction (Jamali et al., 2009). If high standards are not achieved in pain management, patients may have negative experiences with their recovery process when discharged post-operatively back to their homes (Levy & Mashoof, 2000). Furthermore, family members need to be highly involved in watching for signs of infections, deep vein thrombosis, and other complications in the critical period, which is the first 24 hours immediately following the UKA. If caregivers are not equipped or engaged enough to help with caring for patients' wounds, facilitating their exercises, and assisting in managing their pain between nursing, physical therapy, and physician visits, patient satisfaction and quality outcomes could be negatively affected. The first 24 hours after the UKA is performed is a very critical time for the patient; performing the UKAs in the inpatient setting can minimize caregiver-related concerns because non-hospital caregivers are not required to actively participate in patient care (Borus & Thornhill, 2008).

Furthermore, the impacts to the involvement of hospitals, individual physicians, and physician groups are unclear. Although the motivation behind transitioning to outpatient UKAs should be to reduce process time, reduce costs, increase quality outcomes, and increase patient satisfaction; a profit-driven motivation could take priority over these other equally important factors, making them tertiary issues. There may need to be government and industry investments, support, and cultural changes that would enable positive impacts on the system as a whole. If this is not the case, then only certain stakeholders will see the benefits and others will be left taking responsibility for the costs with minimum positive impacts (Jamali et al., 2009).

Rationale

A lack of analysis exists in the literature regarding procedure-by-procedure transitions from inpatient to outpatient settings based on process time, quality outcomes, and patient satisfaction on the patient level (Fulton, Lasdon, McDaniel, & Coppola, 2008). Furthermore, since UKAs are in the early stages of being performed in the outpatient setting, little literature exists regarding outpatient UKAs (Berger et al., 2009; Borus & Thornhill, 2008; Jamali et al., 2009; Larsen et al., 2012). Comparing outpatient UKAs with inpatient UKAs will add to the limited literature that exists on the topic at an early stage of UKAs being performed in the outpatient setting. The analysis will focus on comparing outpatient and inpatient UKAs at the patient level in the categories of process time, quality outcomes, and patient satisfaction.

An example of a surgery that has completely transitioned in the United States from inpatient to outpatient, is Cataract eye surgery. This ophthalmological surgery transition has been thoroughly studied. In the United Kingdom, for example, Cataract surgery performed in the outpatient setting had less reported post-operative problems and greater improvement in quality of life and functional status (Browne et al., 2008). In Spain, a comparison of outpatient Cataract surgeries to inpatient Cataract surgeries revealed that, overall, there was no difference in perceived and actual clinical outcomes (Castells et al., 2001). However, the cost of the Cataract surgery was less in the outpatient setting than it was in the inpatient setting. Despite those statistics, in Australia, some Cataract surgeries still take place in the inpatient setting (Lansingh, Carter, & Martens, 2007). Lansingh, Carter, and Martens (2007) found that patients over the age of 60 that underwent Cataract surgeries in the outpatient setting had the same perceived visual function and patient satisfaction as those in the inpatient setting. Costs were, however, consistently significantly less, an average of $308, for Cataracts performed in the outpatient setting as compared with the inpatient setting.

Outpatient orthopedic surgeries have also been studied. In the United Kingdom, hip replacements performed in the outpatient setting had an improved functional status (Browne et al., 2008). Performing outpatient Bankart shoulder joint repair surgery provided cost savings of 56% when compared with the same inpatient procedure (Levy & Mashoof, 2005). Studies of various types of knee surgeries (non-unicondylar) indicate that quality is comparable and costs are lower in outpatient settings. Strobel (2010) in Germany found that outpatient total knee arthroplasty recorded as high levels of high-quality outcomes and effectiveness as surgeries performed in the inpatient setting. Additionally, the study found that outpatient total knee arthroplasty was more cost effective and cost efficient than inpatient total knee arthroplasty (Strobel, 2010). The study found that there were around

40% savings for outpatient knee arthroscopy, 63% savings for outpatient ACL reconstruction, and 84% cost savings for outpatient shoulder arthroscopy (Strobel, 2010). For ACL reconstruction surgery performed in the two settings, there were no differences in clinical outcomes (Krywulak, Mohtadi, Russell, & Sasyniuk, 2005). Outpatient total knee arthroplasty had comparable quality outcomes as inpatient total knee arthroplasty across similar protocols and different surgeons (Kolisek, McGrath, Jessup, Monesmith, & Mont, 2009).

As mentioned earlier, significant gaps exist in the research when it comes to assessing the performance of UKAs in the outpatient as compared to the inpatient setting. In fact, researching all variations of knee types (unicondylar, unicompartmental or partial) and knee procedures (arthroplasty or replacement) with respect to the transition from inpatient to outpatient surgery has not yielded a large number of peer-reviewed literature sources (Berger et al., 2009; Jamali et al., 2009; Larsen et al., 2012). However, the little research that has taken place with regards to outpatient UKAs has focused on comparing it to total knee replacement, both with the quality of life and the efficacy of discharging patients straight to home care as the main measures of justifying the transition to the outpatient setting. For example, one study applied results from total knee arthroplasty to inpatient UKA, stating that, since outpatient total knee replacements were found to be safe, then UKAs should also be safe in the outpatient setting (Berger et al., 2009).

No literature exists that compares outpatient UKA quality outcomes or patient satisfaction with inpatient surgeries. One study found that UKAs could be a cost-effective alternative to total knee arthroplasty (Jamali et al., 2009). This study concluded that UKAs in the outpatient setting could provide cost savings of over $9,000, or 43% of the total, as compared with the inpatient setting (Jamali et al., 2009). Currently, the one article in the literature that discusses transitioning to outpatient UKAs only analyzes clinical outcomes. No comparisons were made to the inpatient setting.

It can be seen that research that considers process time, quality outcomes, and patient satisfaction of outpatient UKA is lacking. Analyzing quality outcomes is key to measuring the impact of changes made to the processes of procedures. When attempting to change the status quo of clinical practice, the first principle is determining the impact on quality outcomes. However, it is important to note that quality outcomes do not exist in a vacuum; process time, costs and patient satisfaction are directly related concepts that must also be addressed.

Process time is a factor related to cost – the more time a patient is in a facility, the more costs associated with caring for a patient (Munnich & Parente, 2014). Since the outpatient setting does not have the capacity to house patients overnight, patients are stabilized and discharged back home as soon as possible, saving costs. Cost implications of outpatient UKAs are important because one must determine if there is a benefit in performing UKAs in the outpatient setting compared with the inpatient setting, based on the differences in costs. For example, significant factors in the inpatient setting may include overhead of the entire hospital, staffing, equipment, and infrastructure costs. The costs in the outpatient setting are trimmed down because there is less overhead associated with performing the surgeries, which in turn leads to less cost shifting (Jamali et al., 2009).

Patient satisfaction is important in order to promote a patient-centered environment. (DiGioia, Lorenz, Greenhouse, Bertoty, & Rocks, 2010). The perception of the patients is an important factor in the sustainability of a facility because patients who are not satisfied with their care will impact their physician’s use of a facility when there are alternatives. Through word of mouth, these patient perceptions can spread to other potential patients. If the quality outcomes and costs are both improved by a procedure setting change, but the patient satisfaction is decreased, then there is a measure of failure. Patient satisfaction and quality of life provide a way to measure, and therefore impact, patient centered care. However, there has not been an established and concrete way to positively impact patient centeredness without increasing costs. Clinical and non-clinical factors have been directly and indirectly linked to patient centeredness. Patient centeredness has had a long history of development and has become part of the practice of medicine on both the clinical and administrative sides of healthcare. The focus on both the patients' and caregivers' wants and needs is paramount to the success of any facility and physician. Improving experiences pre- and post-operatively increases patient centeredness, which should, in turn, improve patient satisfaction (DiGioia, Lorenz, Greenhouse, Bertoty, & Rocks, 2010).

Looking at all of these factors (process time, quality outcomes, and patient satisfaction) together allows for a well-rounded and thorough approach. The issue of whether outpatient surgery lowers costs while maintaining or improving quality outcomes and patient satisfaction has major policy implications and concerns (Dlugacz & Stier, 2005). Many nations around the globe are having discussions about how to sustainably provide health services that have both high quality outcomes and patient satisfaction (Bramesfeld, Wedegärtner, Elgeti, & Bisson, 2007). One of the greatest pressures comes from the threat of major financial cuts for the healthcare system nationally (The Future of U.S. Health Care, 2009). Since healthcare is under scrutiny, the case for increasing quality outcomes and patient satisfaction while controlling costs must be promoted (Gamotis, Dearmon, Doolittle, & Price, 1988). Transitioning to the outpatient setting for procedures may be a solution that can be implemented to positively impact process time, quality outcomes, and patient satisfaction in the future.

Research Question

Does the setting (outpatient or inpatient) in which unicondylar knee arthroplasty (UKA) is performed impact Process Time, Quality Outcomes, and Patient Satisfaction?

CHAPTER TWO: REVIEW OF THE LITERATURE

Literature Review

Transitioning procedures to the outpatient setting, through addressing process time, quality outcomes, and patient satisfaction, could be a solution to many of the problems facing the healthcare system. Many patients do not need inpatient care for procedures that are available in the outpatient setting. Studies have shown that the outpatient setting is a viable option for various procedures (Browne et al., 2008; Chukmaitov et al., 2008; Gamotis et al., 1988; Haack, 2010; Strobel, 2010; Welsh, 1995). In fact, the outpatient setting has demonstrated lower readmission rates than procedures performed in the inpatient setting (Stieber, Brown, Donald, & Cohen, 2005). This viability extends across different types of quality outcomes and patient satisfaction indicators for the outpatient setting. However, the procedures that will potentially be transitioned must be selected based on evidence-based practices to ascertain which procedures can be safely performed in the outpatient setting. It is important to note that inpatient services cannot always be substituted with outpatient services, such as with cases of acute surgical trauma.

Cataract eye surgery is an example of a procedure that, studies show, has been safely transitioned to the outpatient setting in many countries, including the United States. However, some countries, such as Spain, the United Kingdom, and Australia have not fully transitioned cataract surgeries to the outpatient setting, which allows for a comparison to the inpatient setting in regards to process time, quality outcomes, and patient satisfaction. A study reviewing 935 cataract surgeries performed in Spain found that there were cost savings of 200 Euros per procedure in the outpatient setting; there were no statistically significant differences found after four months for either quality outcomes or patient satisfaction as compared with the inpatient setting (Castells et al., 2001). Fewer post-operative problems as well as increased patient satisfaction and visual function were reported in cataract surgeries performed in the outpatient setting in the United Kingdom (Browne et al., 2008). An analysis of cataract surgeries performed in Australia, in the outpatient and inpatient settings, found that costs, quality outcomes, and patient satisfaction were impacted (Lansingh, Carter, and Martens, 2007). While visual function was the same in the outpatient setting, recovery time was less. Costs and charges were significantly less in the outpatient setting as compared with the inpatient setting, although patient satisfaction was comparable in both settings. These studies posit that there is justification for surgeries to be transitioned to the outpatient setting based on the measured costs, quality outcomes, and patient satisfaction.

In the following sections, analyses of studies are presented regarding process time, quality outcomes, and patient satisfaction of outpatient procedures in general and UKAs in particular. Following that, a discussion regarding the limitations of these studies and subsequent areas that need further research will be presented.

Literature Comparing Outpatient Procedures with Inpatient Procedures

The studies reviewed will focus on four major categories: process time, quality outcomes, and patient satisfaction. Many of these categories include more than one variable compared in both the outpatient and inpatient setting.

Process Time

One study found that the time spent performing procedures is significantly less in the ambulatory surgery setting (Munnich & Parente, 2014). This study compared hospital outpatient departments and ambulatory surgery centers in order to explore the impact of process time on costs. The process time of performing surgeries in the ambulatory outpatient setting averaged thirty-two minutes less than in the hospital outpatient setting. The time saved meant that more procedures could be performed per day while costs per procedure were reduced. Due to less operating room time, there was cost savings of $54.50 per minute, which adds up to approximately $637 of savings per procedure (Munnich & Parente, 2014). However, this study did not analyze quality outcomes or patient satisfaction.

Quality Outcomes

There have been several studies that have compared quality outcomes for procedures performed in the outpatient versus inpatient settings. One study compared total knee arthroplasties across different surgeons and found that quality outcomes were comparable or improved for outpatients as compared with inpatients, with the added benefit of the patients not spending days in the hospital (Kolisek, McGrath, Jessup, Monesmith, & Mont, 2009). A study found that the post-operative physical condition (i.e. functionality and range of motion) of outpatients was similar or better than their inpatient counterparts. Another study compared outpatient anterior cervical dissection and fusion in the outpatient and inpatient settings, and it was found that complication rates were lower in the outpatient setting (Stieber, Brown, Donald, & Cohen, 2005).

In a study looking across various quality outcomes and quality of life indicators (such as rates of infection, level of satisfaction, and number of work days missed), it was found that the outcomes for procedures performed in the outpatient setting were superior to those performed in the inpatient setting (Browne et al., 2008). The United Kingdom Department of Health conducted a study measuring quality outcomes over a one-year period – between 2006 and 2007 – that compared the National Health System's inpatient setting (1895 patients from twenty facilities) with the outpatient setting at Independent Sector Outpatient Treatment Centres (769 patients - from six facilities) (Browne et al., 2008). This was a retrospective study that utilized a cohort sample and measured various types of procedures from diverse specialties. These specialties included orthopedics, ophthalmology, and general surgery and focused on hip and knee replacements, cataract extractions, and inguinal hernia repairs and varicose vein surgery, respectively. The study was controlled for patient comorbidities and demographics through the use of multiple regression (Browne et al., 2008). The authors noted that future research can expand on their methodology and increase the number of indicators can expand upon this methodology and increase the number of indicators and specialties that are analyzed.

Patient Satisfaction

Some studies have focused on comparing patient satisfaction regarding procedures performed in the outpatient and inpatient settings. One study found that patients' and caregivers' psychological well-being and patients' global quality of life were higher in the outpatient setting for those receiving high-dose chemotherapy and autologous stem cell transplantation. The study found major improvements of normal activity patterns as measured by physical performance score answers in the outpatient setting (Summers, Dawe, & Stewart, 2000).

Another study focused on the specific aspects unique to the outpatient setting that had an impact on patient satisfaction. The study analyzed 183 patients and found that elective general surgery patients were more satisfied with their nursing care in the outpatient setting (Gamotis, Dearmon, Doolittle, & Price, 1988). This study was conducted by utilizing data from a local Alabama hospital, where the researchers used a standardized questionnaire to assess patient satisfaction. In the inpatient setting, patients receive instructions from many different staff members and receive care and interaction from many different nurses. In the outpatient setting, there are specialized nurses who have more time and resources to devote to their patients. These nurses remain with the patient from before their treatment until their discharge, and they even participate in following up with the patient after discharge. Most of the patient satisfaction and patient centeredness measurements were attributed to the fact that individualized structured instructions were given to the patient on a one-on-one basis both before and after the procedure. Thus, the level of patients' trust increased when nurses communicated through personal instructions, leading patients to have a higher level of patient satisfaction in the outpatient setting as compared with the inpatient setting (Gamotis et al., 1988). Although patients who were treated at the local hospital were asked to sign consent forms before they participated in this study, they remained anonymous throughout the research. Because of their anonymity, the link between outcome data and their satisfaction was weakened. The study would have been strengthened if methods were modified so that patient satisfaction was compared with clinical outcomes. This study found that there are distal measures of quality outcomes and patient satisfaction. Future research could combine both proximal and distal measures with analysis of quality outcomes and patient satisfaction.

Combined Approach

Other studies have examined impacts of outpatient procedures in more than one of these areas. One study found that quality outcomes and patient satisfaction were better in the outpatient setting, even when different physicians performed the same procedures (Carayon, Hundt, Alvarado, Springman, & Ayoub, 2006). This study reviewed five outpatient facilities utilizing both quantitative (closed-ended questions) and qualitative (open-ended questions) measures and found that transitioning to outpatient centers resulted in higher quality service and patient satisfaction. In fact, the number of overall complications decreased and no hospitalizations were required for anterior cervical discectomy and fusion.

A study analyzing quality outcomes and costs for laparoscopic cholecystectomy found that quality outcomes were comparable or improved in the outpatient setting (Paquette, Smink, & Finlayson, 2008). Patients that needed to return and be admitted for any reason after their surgery still required shorter hospital stays if their procedure was performed in the outpatient setting. Outpatient laparoscopic cholecystectomy had reduced costs, from $11,785 to $6,106, with savings of approximately $5,700 per patient as compared to the inpatient setting.

Studies of knee and shoulder surgical procedures have shown that patient satisfaction and patient centeredness was better and costs were lower when procedures were performed in the outpatient setting (Krywulak et al., 2005; Levy & Mashoof, 2000). Costs to institutions were cut by more than half when performed in the outpatient setting (Krywulak et al., 2005). Although quality outcomes were the same across multiple indicators in ACL reconstruction surgery patients, their satisfaction was higher when the procedure was performed in the outpatient setting as compared with the inpatient setting (Krywulak et al., 2005). With patients discharged to their homes after surgery, costs for outpatient Bankart shoulder repair were reduced by over 56% and resulted in high patient satisfaction of 88% (Levy & Mashoof, 2000). Similar statistics were noted and costs were applied to and for patients who were in need of further surgery in the same anatomical region.

Some studies compared differences when surgeries were performed in hospital outpatient departments as compared with ambulatory surgery centers. These studies emphasized that procedures performed in hospital outpatient departments have lower quality outcomes, higher costs, and longer procedure imes than those performed in a free-standing ambulatory facilities (Chukmaitov, Menachemi, Brown, Saunders & Brooks, 2008; Munnich & Parente, 2014). When broken down by procedure, it has been found that, across various non-acute surgeries, the outcomes are better with fewer hospitalizations in the ambulatory surgery setting. This study found major improvements of physical therapy score answers in the outpatient setting (Chukmaitov, Menachemi, Brown, Saunders & Brooks, 2008).

Literature Comparing Outpatient UKAs with Inpatient UKAs

A focused look at the literature involving orthopedic knee replacements, found that some pioneers in orthopedics have taken it upon themselves to transition Unicondylar Knee Arthroplasties (UKAs) to the outpatient setting (Borus & Thornhill, 2008). UKA refers to the replacement of one compartment (lateral or medial) of the knee (Partial knee replacement, 2008). This type of surgery has long been performed in the inpatient setting, and, to this day, the vast majority are still similarly performed, with patients staying at least one night in the hospital (Larsen et. al, 2012). In 1991, experimentation with improved processes for UKAs started so that, by 2006, physicians started performing UKAs in the outpatient setting (Jamali et al., 2009). Advancements in technology have allowed an increasing number of highly skilled and highly specialized physicians to operate in the outpatient setting, with a same-day discharge back to the patient's home (Berger et al., 2009). All of the corresponding services of physical therapy, nursing care, and pain management are then conducted in the comfort of the patient’s home, which decreases both the risks of infection and the level of discomfort of the patient. Additional, benefits have also been reported with outpatient UKAs, such as decreased process time, increased quality outcomes, increased patient satisfaction, decreased pain, and decreased recovery time all while controlling costs.

Currently, only three peer-reviewed studies have empirically analyzed the effects of performing UKAs in the outpatient setting (Berger et al., 2009; Jamali et al., 2009; Larsen et al., 2012). One such study surveyed 211 patients twice pre-surgery and twice post-surgery through three separate standardized survey instruments (Larsen et al., 2012). Researchers found that, in four-month and twelve-month follow-ups, patients had improved function and satisfaction after outpatient UKAs (Larsen et al., 2012). The focus of this study was fast track knee arthroplasty in general, including both total knee arthroplasties as well as UKAs. This study did not explicitly compare UKAs in the outpatient versus the inpatient setting.

In another study reviewing 111 same-day patients over a ten-month period, researchers found that outpatient knee arthroplasties have high quality outcomes across clinical indicators (Berger et al., 2009). This study reviewed a consecutive cohort of eighty-nine total knee arthroplasties and twenty-five UKA patients based on multiple indicators such as anemia, gastrointestinal bleeding, and deep vein thrombosis. The primary focus of this study was on the feasibility of transitioning knee arthroplasty to the outpatient setting based on quality outcomes. Of the twenty-five outpatient UKA patients in the study, none required readmission or emergency room visits. With the exception of one patient that required an overnight stay due to nausea, no patients had any complications by the last follow up appointment – which was three months post-operative. Outpatient UKAs had less post-operative readmissions and complications than traditionally seen in the inpatient setting. The study did not focus on patient satisfaction or cost implications as justifications for transitioning UKAs to the outpatient setting. The study analyzed a very small number of UKA patients and did not directly compare the inpatient and outpatient setting (Berger et al., 2009).

The third study on outpatient UKAs looked at the history, current progress, and future possibilities of UKAs (Jamali et al., 2009). Although it reviewed the literature available on UKAs in general, it did not make direct comparisons of inpatient and outpatient UKAs in a detailed manner. Cost implications of UKAs in the outpatient setting were touched on, by stating that costs were reduced from an average of $16,000 in the inpatient setting to $7,000 in the outpatient setting, but no further details were given. An important factor that was noted in the article was that the cost reduction would only be attained if the quality outcomes were maintained throughout the process. For example, post-operative pain would have to be controlled throughout the post-operative period for quality outcomes to result in cost reductions. Patient satisfaction was not directly measured in this study. The authors in the study predicted that, in the future, UKAs will more regularly be performed in the outpatient setting.

Limitations of Studies on the Impacts of the Outpatient Setting

There is a potential concern that the outpatient setting is biased towards healthier individuals. Researchers have performed risk adjustments in their studies to decrease the impact of different biases, such as channeling bias, in order to more accurately compare patients in the outpatient and inpatient settings (Berger et al., 2009; Browne et al., 2008; Chukmaitov et al., 2008; Eun-Hye et al., 2011; Josephson & Barnett, 2004; Strobel, 2010). This study will be risk-adjusted to control for demographics, comorbidities, and contraindications when comparing the outpatient and inpatient setting in order to standardize the cross-sectional comparison between the two settings.

One of the main limitations is that many studies do not link the variables to one another on the patient level. Many studies make claims regarding the impacts of outpatient care on multiple variables without detailing and enumerating what those impacts are across the variables. Each variable is treated as mutually exclusive and therefore analysis of the full impact of the outpatient setting cannot be made. This study will analyze multiple outcome variables on the patient unit level.

Another limitation is whether the studies adequately controlled for confounding variables. It is not within the scope of many studies to track the small differences between physicians, facilities, and procedure types, which can have impacts on process time, quality outcomes, and patient satisfaction. These issues – before, during, and after surgery – can have major impacts on patients, both physical outcomes and mental perceptions. The short time frame in which the study will take place minimizes these issues: implants, surgical techniques, anesthesia techniques, post-operative pain management, post-operative physical therapy, and care providers will remain the same.

Another limitation found in studies regarding the outpatient setting is the generalizability of study conclusions. There are limitations regarding the generalizability of some outpatient studies. Many studies make claims in sections, other than the analysis and results sections, regarding other variables that were not specifically measured. Since many of these studies do not make direct comparisons, the outpatient setting cannot be claimed to be better than the inpatient setting. This limitation makes it difficult to make concrete conclusions regarding the relationship between the impacts of the outpatient setting on multiple variables. One other factor that leads to issues of generalizability has to do with the specific nature of the studies regarding comparisons of the outpatient setting with inpatient. Many studies do not directly focus on comparing the outpatient and inpatient settings across many variables. Much like the issues with specifically measuring variables, the comparisons are not discussed within the analysis and results sections of studies; rather, they are examined or briefly noted in other sections. This study aims to directly compare the outpatient and inpatient setting across multiple variables. This study looks to address the generalizability by creating thorough methodology and theoretical framework that can be utilized for other procedures, variables, and settings.

Theoretical Framework

Theories

As illustrated in Figure 1, a theory-guided framework will be utilized to assist in comparing outpatient UKAs with inpatient UKAs. The theoretical approach is based upon the area of management known as Organizational Science. Organizational Science explains the environmental context of an organization and explains how the foundations and frameworks of that organization are structured (Mintzberg & Van der Heyden, 1999). Applying Organizational Science to the comparison of outpatient UKAs with inpatient UKAs allows for various theories and tools to be utilized to guide the analysis. These theories include Contingency Theory, Organizational Performance Theory, and reengineering. Contingency Theory and Organizational Performance Theory will be combined to create a basis for Donabedian's Structure, Process, and Outcomes model (SPO model). Contingency Theory and Organizational Performance Theory will be combined to create a basis for Donabedian's Structure, Process, and Outcomes model (SPO model). Reengineering utilizes the information gathered about the external environment and the organizations structure, process, and outcomes in order to implement the changes necessary for transitioning to outpatient UKAs. The knowledge attained from applying these theories will guide the methodology of conducting a study on how to generate improved process time, quality outcomes, and patient satisfaction for future outpatient procedures. Contingency theory combines the environmental context and specific organization operations of healthcare. The recent Affordable Care Act, as an example to apply to this theory, created a reimbursement and incentive structure for quality outcomes. This act aims to impact the healthcare structure and processes to generate positive outcomes. Therefore organizations are having to adapt to the environmental context of improving quality. Reengineering utilizes the information gathered about the external environment and the organizations structure, process, and outcomes in order to implement the changes necessary for transitioning to outpatient UKAs. The knowledge attained from applying these theories will guide the methodology of conducting a study on how to generate improved process time, quality outcomes, and patient satisfaction for future outpatient procedures.

On the other arm, Organizational Performance Theory looks at the internal organization components and how they impact the outcomes. Better outcomes leads to better population health. Healthcare management and research has centered around using Donabedian's model as the core of the framework for analysis. Policy makers, researchers, and healthcare administrators, the joint commission, and hospitals utilize the structure process and outcomes model to effect change within the organizations and in the system as a whole. As the outcomes are generated, organizations can utilize reengineering to create a continuous improvement feedback loop in an evidence based manner. All of these areas go beyond organization to impact the society and community. As these outcomes are generated, the core of the Structure, Process, and Outcomes Model can be utilized for a broader approach in different contexts. As the analysis within organizations are completed, the findings can translate back to health reform and policy.

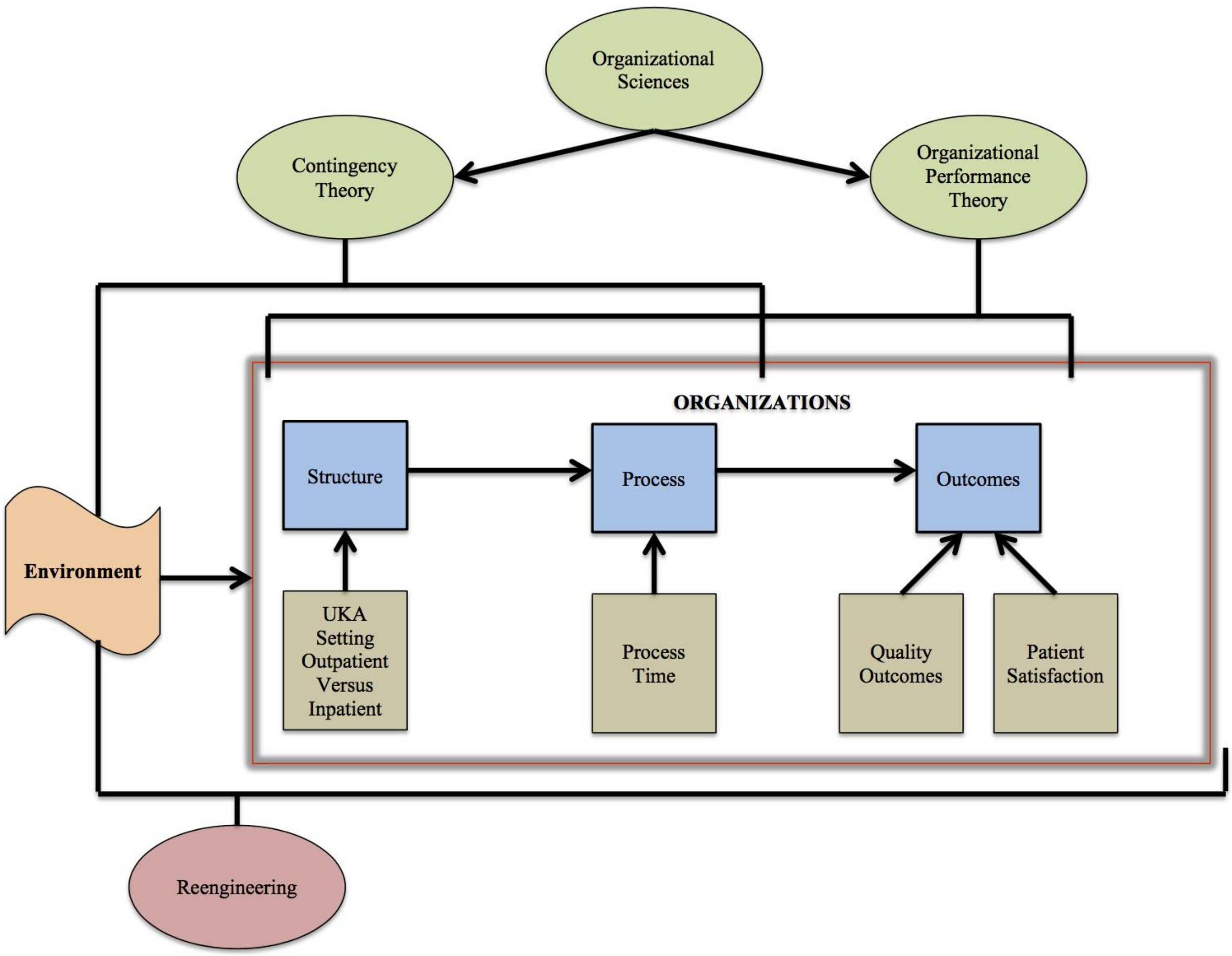

Figure 1. Theoretical Framework

Contingency Theory

Contingency Theory addresses the complex nature of organizations and their environmental context in the micro and macro perspectives (McMahon & Perritt, 1973). Contingency Theory discusses the normal reaction of organizations to external environmental factors that can impact an organization, including changes in professional standards, culture, laws, competition, and industry movements. Additionally, this context also includes changes to regulations, changes to standards of care, changes to the industry, and changes in other factors. Organizations will adapt their structure and processes to react to these environmental factors (Wang, 2010). Therefore, Contingency Theory can apply the current environmental context of focusing on quality outcomes and patient satisfaction while controlling costs. Moreover, Contingency Theory applied within an organization creates structures and processes that can address the multi-level design problems that organizations face (Fried, 1988). In this way, Contingency Theory explains that organizations will want to transition procedures to the outpatient setting, specifically outpatient UKAs, based on the developments in the industry, competition, and other factors.

The ability to bridge these areas is the foundation of Contingency Theory – it is often thought that Contingency Theory is the generalist theory of management and policy – whether these areas are health, academic, private, or governmental in nature (Luthans & Stewart, 1977). Moreover, Contingency Theory formalizes the structures and processes of an organization so that it will function optimally, effectively, and efficiently (Robinson, 1997). Additionally, it is much more valuable when utilized in conjunction with other management approaches and concepts, like those of Organizational Performance Theory (Greenwood & Miller, 2010).

Organizational Performance Theory

Organizational Performance Theory posits that the known inputs and outputs of each organization, as well as the structure, framework, and policies of these organizations, have a direct impact on the resources and the outcomes that are produced (Mintzberg & Van der Heyden, 1999). Organizational Performance Theory is a naturally adaptable concept where each organization has a unique set of requirements, inputs, outputs, and measures (Hannan & Freeman, 1984). Organizational Performance Theory combines these factors into definable, grounded, and measurable goals and strategies (Talbot, 2008). Organizational Performance Theory should not be a rigid and formulaic strategy; rather, it should be a customizable concept that can be utilized to meet needs unique to each organization (Longeneecker & Pringle, 1978). The fundamental goal of an organization is to create performance outcomes based on the resources that the organization can access (Ruef, Mendel, & Scott, 1998). These goals and strategies interact with inputs to create outcomes that can be measured by the use of effectiveness and efficiency analyses (Bazzoli, Shortell, Dubbs, Chan, & Kralovec, 1999). Based on the environmental context, Organizational Performance Theory translates abstract goals into practical applications that will then generate positive outcomes (Walker, Damanpour, & Devce, 2011).

Combined Contingency and Organizational Performance Theory

Contingency Theory and Organizational Performance Theory overlap and complete the picture of the framework of the comparison of outpatient UKAs with inpatient UKAs. Although Contingency Theory examines the reaction of organizations to the external environment, it does not explain the relationship of these changes to the outcomes. On the other hand, Organizational Performance Theory explains how the organization will internally change its structure and processes to generate positive outcomes. These changes are based on goals that the organization develops, whether it is a reaction to external factors or not. Additionally, Organizational Performance Theory explains that the goal of generating positive outcomes will dictate how the structure and processes will need to change. An overlap of the theories exists in tying organizational changes to the structure, process, and outcomes.

Donabedian's Structure, Process, and Outcomes Model

Donabedian's Structure, Process and Outcomes (SPO) Model is based on Organizational Science and is closely related to Contingency Theory and Organizational Performance Theory. This model is utilized in healthcare management as a conceptualization of the components found in each of the theories previously mentioned (Donabedian, 1980a). Contingency Theory explains how organizations adapt to external factors located in the environment around an organization by making necessary changes to its structures and processes. Organizational Performance Theory explains how the structure and processes of an organization determine its outcomes and how those outcomes are the organization's goal. The overlap previously discussed exists in the different aspects of an organization that are defined in the Structure, Process, and Outcomes Model (SPO). Utilizing Donabedian's

Structure, Process, and Outcomes Model is essential to transitioning procedures to the outpatient settings generally and outpatient UKAs specifically (Donabedian, 1980b). The model is utilized to understand the interactions of the different components of an organization, where the structure and process lead to outcomes (Donabedian, 1981).

Reengineering

Reengineering is a direct application of Organizational Science; Contingency Theory; Organizational Performance Theory; and Donabedian's Structure, Process, and Outcomes Model. Through reengineering, organizations can implement best practices found in the external environment into the structure and processes. By utilizing reengineering, an organization can shift away from the traditional inpatient-centered approach to an outpatient-centered approach, specifically concerning outpatient UKAs. Rather than incremental changes internally, reengineering finds its strength in allowing for a complete paradigm shift of an organization, radically altering the structure and processes to achieve improved outcomes (Rao, Mansingh, & Osei-Bryson, 2012). Although the changes to an organization can be radical, the approach of reengineering is systematic in nature (Chang, 2007). Strategic step-by-strategic-step, organizations implement continuous improvements to the structure and processes during the radical shift that comes with applying reengineering (Nissen, 2000). Implementing monitoring and surveillance systems into the process, for instance, will allow for modifications to be made along the redesigned processes (Giff & Crompvoets, 2008). If all of the changes are thoroughly applied, measured, and constantly adjusted, this cyclical process will ideally and eventually lead to improved outcomes (Hammer & Champy, 1993).

In summary, transitioning procedures to the outpatient setting, specifically outpatient UKAs, requires a conceptual and theoretical framework as a guide that is found in Organizational Science. The theories that are applicable to transitioning to outpatient UKAs are Contingency Theory and Organizational Performance Theory, which explain how organizations change based on internal and external factors and requirements to do so. Furthermore, Donabedian's Structure, Process, and

Outcomes Model emphasizes the different components of an organization and how applying various changes will generate quality outcomes. Reengineering is a tool that puts these theories and Donabedian's Model into practice. As a whole, the conceptual and theoretical framework proposed will guide the analyses comparing outpatient UKAs with the inpatient UKAs.

Application of Theories to Transitioning to Outpatient UKAs

Applying Contingency Theory to the transition of UKAs to the outpatient setting means that an organization must adapt to the environmental context of focusing on process time, quality outcomes, and patient satisfaction while controlling costs. The organization has to adapt the structure of inpatient-only UKAs in order to be able to perform UKAs in the outpatient setting, such as training staff to be able to perform outpatient UKAs. Thereafter, an organization can set up the processes of performing the UKA within its newly modified structure. The process includes the technique of performing the actual UKA and the treatment plans that physical therapists and nurses should utilize with their patients once they have been discharged to their homes. As more organizations choose to transition to outpatient UKAs, the environmental context of the industry will continue to shift, encouraging more organizations to adapt to outpatient-centered UKAs.

Organizational Performance Theory as applied to transitioning UKAs to the outpatient setting entails connecting the structure and processes of the procedure to the positive outcomes it wants to generate. Once the goals of reduced process time, reduced costs, improved quality outcomes, and improved patient satisfaction are quantified, this information will be utilized to further modify the structure and processes of an organization to more fully transition it to outpatient setting. Some changes to the structure, such as hiring or training of staff, may not generate the level of improvements to quality outcomes and patient satisfaction the organization is looking for. Therefore, it is essential that the outcomes constantly inform the organization of which components of the organization's structures or processes generate positive outcomes. When combined with Contingency Theory, organizations can more successfully transition to outpatient UKAs, adapting to internal and external factors as they happen and generating positive outcomes.

The application of theories into Donabedian's Structure, Process and Outcomes Model creates a method of utilizing resources to effectively and efficiently change the structure and processes of a healthcare organization in order to create positively measurable quality outcomes (Donabedian, 2005). Transitioning to outpatient UKAs will require changes to the structure and processes of an organization. In this procedure's case, the process of the organization is composed of the different phases of a UKA. These processes can be measured by the process time of each phase of a UKA. The outcomes generated by performing outpatient UKAs are measured through quality outcomes and patient satisfaction. Organizational Performance Theory further emphasizes the link between the structure and process changes and how they generate positive outcomes.

As organizations transition to outpatient UKAs, applying reengineering will fundamentally change their structures and processes. Specifically, reengineering allows for the radical shift away from inpatient UKAs to outpatient UKAs. For example, staff, including physicians, nurses, and physical therapists, will have to be trained in outpatient UKAs, or staff that are already specialized in outpatient UKAs will have to be hired. Since post-discharge services are essential for patients to be discharged to their homes safely, the infrastructure, trained staff, and pain control methods all must be reengineered so that they are able to have a successful recovery that begins right after they leave the facility. Reengineering changes the structure and process to generate outcomes in an informed manner, since it provides real-time information used for continuous improvement.

CHAPTER THREE: RESEARCH DESIGN

Research Question

Does the setting (outpatient or inpatient) in which a UKA is performed impact Process Time, Quality Outcomes, and Patient Satisfaction?

Statements of Hypotheses

Hypothesis 1

Ho_1: There is no difference between Time in the Ambulatory Surgery Unit (ASU)/Pre-Op of UKAs performed in the outpatient setting and the Time in ASU/Pre-Op of UKAs performed in the inpatient setting.

Ha_1: The Time in ASU/Pre-Op of UKAs performed in the outpatient setting is less than the Time in ASU/Pre-Op of UKAs performed in the inpatient setting.

Hypothesis 2

Ho_2: There is no difference between the Surgery Time of UKAs performed in the outpatient setting and the Surgery Time of UKAs performed in the inpatient setting.

Ha_2: The Surgery Time of UKAs performed in the outpatient setting is less than the Surgery Time of UKAs performed in the inpatient setting.

Hypothesis 3

Ho_3: There is no difference between the Surgery Preparation Time of UKAs performed in the outpatient setting and the Surgery Preparation Time of UKAs performed in the inpatient setting.

Ha_3: The Surgery Preparation Time of UKAs performed in the outpatient setting is less than the Surgery Preparation Time of UKAs performed in the inpatient setting.

Hypothesis 4

Ho_4: There is no difference between the Surgery Breakdown Time of UKAs performed in the outpatient setting and the Surgery Breakdown Time of UKAs performed in the inpatient setting.

Ha$_4$: The Surgery Breakdown Time of UKAs performed in the outpatient setting is less than the Surgery Breakdown Time UKAs performed in the inpatient setting.

Hypothesis 5

Ho$_5$: There is no difference between the Time in Operating Room of UKAs performed in the outpatient setting and the Time in Operating Room of UKAs performed in the inpatient setting.

Ha$_5$: The Time in Operating Room of UKAs performed in the outpatient setting is less than the Time in Operating Room of UKAs performed in the inpatient setting.

Hypothesis 6

Ho$_6$: There is no difference between the Time in the Post-Anesthesia Care Unit of UKAs performed in the outpatient setting and the Time in the Post-Anesthesia Care Unit of UKAs performed in the inpatient setting.

Ha$_6$: The Time in the Post-Anesthesia Care Unit of UKAs performed in the outpatient setting is less than the Time in the Post-Anesthesia Care Unit of UKAs performed in the inpatient setting.

Hypothesis 7

Ho$_7$: There is no difference between the Total Enterprise Throughput Time of UKAs performed in the outpatient setting and the Total Enterprise Throughput Time of UKAs performed in the inpatient setting.

Ha$_7$: The Total Enterprise Throughput Time of UKAs performed in the outpatient setting is less than the Total Enterprise Throughput Time of UKAs performed in the inpatient setting.

Hypothesis 8

Ho$_8$: There is no difference between Post-Operative Infections for UKAs performed in the outpatient setting and Post-Operative Infections for UKAs in the inpatient setting.

Ha$_8$: Post-Operative Infections of UKAs performed in the outpatient setting are fewer than Post-Operative Infections of UKAs performed in the inpatient setting.

Hypothesis 9

Ho_9: There is no difference between Post-Operative Complications (not including post-operative infections and Deep Vein Thrombosis (DVT)/Pulmonary Embolism (PE)) of UKAs performed in the outpatient setting and Post-Operative Complications (not including post-operative infections and DVT/PE) of UKAs performed in the inpatient setting.

Ha_9: Post-Operative Complications (not including post-operative infections and DVT/PE) of UKAs performed in the outpatient setting are fewer than Post-Operative Complications (not including post-operative infections and DVT/PE) of UKAs performed in the inpatient setting.

Hypothesis 10

Ho_{10}: There is no difference between Non-Surgery Related Complications of UKAs performed in the outpatient setting and Non-Surgery Related Complications of UKAs performed in the inpatient setting.

Ha_{10}: Non-Surgery Related Complications of UKAs performed in the outpatient setting are fewer than Non-Surgery Related Complications of UKAs performed in the inpatient setting.

Hypothesis 11

Ho_{11}: There is no difference between Deep Vein Thrombosis/Pulmonary Embolism following UKAs performed in the outpatient setting and Deep Vein Thrombosis/Pulmonary Embolism following UKAs performed in the inpatient setting.

Ha_{11}: Deep Vein Thrombosis/Pulmonary Embolisms following UKAs performed in the outpatient setting are fewer than Deep Vein Thrombosis/Pulmonary Embolism of UKAs performed in the inpatient setting.

Hypothesis 12

Ho_{12}: There is no difference between Emergency Room Visits following UKAs performed in the outpatient setting and Emergency Room Visits following UKAs performed in the inpatient setting.

Ha_{12}: Emergency Room Visits following UKAs performed in the outpatient setting are fewer than Emergency Room Visits following UKAs performed in the inpatient setting.

Hypothesis 13

Ho_{13}: There is no difference between Hospitalizations (Admission/Readmission) following UKAs performed in the outpatient setting and Hospitalizations (Admission/Readmission) following UKAs performed in the inpatient setting.

Ha_{13}: Hospitalizations (Admission/Readmission) following UKAs performed in the outpatient setting are fewer than Hospitalizations (Admission/Readmission) following UKAs performed in the inpatient setting.

Hypothesis 14

Ho_{14}: There is no difference between Follow-Up Pain for UKAs performed in the outpatient setting and Follow-Up Pain for UKAs performed in the inpatient setting.

Ha_{14}: Follow-Up Pain for UKAs performed in the outpatient setting is less than Follow-Up for UKAs performed in the inpatient setting.

Hypothesis 15

Ho_{15}: There is no difference between Follow-Up Functional Range of Motion Limitation for UKAs performed in the outpatient setting and Follow-Up Functional Range of Motion Limitation for UKAs performed in the inpatient setting.

Ha_{15}: Follow-Up Functional Range of Motion Limitation for UKAs performed in the outpatient setting is greater than Follow-Up Functional Range of Motion Limitation for UKAs performed in the inpatient setting.

Hypothesis 16

Ho_{16}: There is no difference between Pleased with the Results of UKA for UKAs performed in the outpatient setting and Pleased with the Results of UKA for UKAs performed in the inpatient setting.

Ha_{16}: The Pleased with the Results of UKA for UKAs performed in the outpatient setting is higher than the Pleased with the Results of UKA for UKAs performed in the inpatient setting.

Hypothesis 17

Ho_{17}: There is no difference between the Visual Analog Scale for Patient Satisfaction for UKAs performed in the outpatient setting and the Visual Analog Scale for Patient Satisfaction for UKAs performed in the inpatient setting.

Ha_{17}: The Visual Analog Scale for Patient Satisfaction for UKAs performed in the outpatient setting is lower than the Visual Analog Scale for Patient Satisfaction for UKAs performed in the inpatient setting.

Hypothesis 18

Ho_{18}: There is no difference between Patient Perception of Satisfaction for UKAs performed in the outpatient setting and Patient Perception of Satisfaction for UKAs performed in the inpatient setting.

Ha_{18}: Patient Perception of Satisfaction for UKAs performed in the outpatient setting is higher than Patient Perception of Satisfaction for UKAs performed in the inpatient setting.

Data Source

The outpatient and inpatient data are homogeneous at the provider level, as one physician, J. Mandume Kerina, M.D., the founder of Tri-County Orthopaedic Center, provides the records that will be analyzed. Dr. Kerina collects primary data on patients who have had a UKA performed. Dr. Kerina is credentialed, certified, accredited, and in good standing with government agencies and private payers. This standing means that he has not had any investigations of fraud relating to reimbursement or quality related issues raised against him or his practice – thus increasing the veracity and validity of the data.

The outpatient and inpatient patient data are located in the Electronic Medical Records (EMR) of eClinicalWorks version 10 system for Dr. Kerina's patient records and Excel reports provided by TLC Surgery Center and a Lake County Regional Hospital. An exhaustive chart review using manual data extraction and recording based on physician notes and scanned versions of paper forms had to replace an integrated EMR system. Often, when it was actually stored in an electronic format, this data was located in different areas and a search had to be conducted to locate the information. No data pulls or queries could be performed in these databases because they were not enabled for these actions.. The researcher abstracted data from electronic patient visit information, clinician notes, scanned documents, from facilities as is described in Data Dictionary located Appendix B.

A confidentiality agreement was required and signed in order to access the EMR systems. The facility provided a signed letter authorizing full use and analysis of the data, as seen in Appendix C. The UCF Institutional Review Board (IRB) approval was originally attained in December 10, 2014 with an Exempt Determination, as seen in Appendix D. An amendment to change the title of the dissertation was approved on June 1, 2015, as seen in Appendix E. A final amendment to change the title of the dissertation was approved on November 1, 2015, as seen in Appendix F.

Design

The design of the study will be a retrospective analysis of the secondary data requested from Dr. Kerina for UKAs performed in both the outpatient settings and the inpatient settings. Computer databases will allow for a cross-sectional analysis for dates of service from January 1, 2009 to December 31, 2014 for Demographics, Comorbidities, Process Time, Quality Outcomes, and Patient Satisfaction. Moreover, this information is combined into treatment episodes for UKA patients, from the onset of pain until completion of treatment. As stated previously there was insufficient data to conduct a statistical analysis of the cost variables of Gross Charges, Direct Costs, and Revenue. This will therefore be discussed further in the Chapter 5 Discussion, Future Research, and Limitations sections.

Inclusion and Exclusion

The time period of this study begins on January 1, 2009 due to a major change in CMS policy. CMS made a determination that UKAs will be reimbursed if performed in the outpatient setting. The lack of reimbursement for outpatient UKAs prior to January 1, 2009 was only based on protocols of payment and not clinical values and determinations. For patients in the practice, after medical clearance was issued, based on the requirements of the physician, no patients were denied by the payers or facilities. To undergo a UKA a patient's comorbidities had to be stable (on medication or treatment) as a requirement for medical clearance. This medical clearance is based on the American Society of Anesthesiologists (ASA) Physical Status 3 Classification: a patient may have some limitations functionally and/or has a controlled disease in a system of the body with no immediate risk of death (Davis, 2011).

Measures

Independent Variable of Interest

The independent variable of interest is the setting in which the UKA was performed, as seen in Table 1 and the Data Dictionary in Appendix B. This variable denotes whether the UKA was performed in the outpatient setting or the inpatient setting. Setting is part of the Structure component of Donabedian's Structure, Process, and Outcomes Model.

Independent Variables: Controls

There are four control variable categories, as seen in Table 2 and the Data Dictionary in Appendix B. The first control variable category is patient demographics, which is measured by the Age, Gender, Race, and Marital Status. The next category is Social History, measured by Employment Status, Alcohol Consumption, Tobacco Use, and Physical Activity. The next category is surgery-related variables, measured by the Year of Service, the knee the UKA was performed on, and the implant type (Biomet Oxford or the Zimmer Zuk). Another control variable category is the Charlson Index, which is on based presence of Cancer, COPD, Degenerative Disc Disease, Diabetes, Heart Attack, Hepatitis, HIV, or Stroke.

Dependent Variables

There are four categories of dependent variables, as seen in Table 3 and the Data Dictionary in

Appendix B. The variables were chosen based on the availability in the medical record and clinical relevance. The first variable category is Process Time, and it is measured by the Time in Ambulatory Surgery Unit (ASU)/Pre-OP, Surgery Time, Surgery Preparation Time, Surgery Breakdown Time, Time in Operating Room, Time in Post-Anesthesia Care Unit (PACU), and Total Enterprise Throughput Time. Process Time is part of the Process component of Donabedian's Structure, Process, and Outcomes Model.

The second variable category is Quality Outcomes. These outcomes are measured by Post-Operative Infections, Post-Operative Complications, Non-Surgery Related Complications, Deep Vein Thrombosis/Pulmonary Embolism, Emergency Room Visits, Hospitalizations (Admission / Readmission), Follow-Up Pain Level, and Follow-Up Functional Range of Motion Limitation. Quality Outcomes are part of the Outcomes component of Donabedian's Structure, Process, and Outcomes Model.

The third variable category is Patient Satisfaction, which is measured by whether or not the patients were Pleased with the Results of UKA, the Visual Analog Scale (VAS) for Patient Satisfaction, and the Patient Perception of Satisfaction. Patient Satisfaction is part of the Outcomes component of Donabedian's Structure, Process, and Outcomes Model.

Table 1. Conceptualized Independent Variable

Variable Category {SPO Model}	**Variable Name**	**Measurement Method**	**Description**	**Analysis Method**
Unicondylar Knee Arthroplasty Procedure Setting {Structure}	Procedure Setting	Dummy Coded	The setting in which UKA was performed –Outpatient or Inpatient	N/A

Table 2. Conceptualized Control Variables

Variable Category	Variable Name	Measurement Method	Description	Analysis Method
Surgery Related	Year of Service	Categorical	Year the UKA was performed: 2009, 2010, 2011, 2012, 2013, or 2014	N/A – Control
	Knee	Categorical	The knee that the UKA was performed: Left Knee, Right Knee, or Both Knees	N/A – Control
	Implant	Dummy Coded	What implant was utilized: the Biomet Oxford or the Zimmer Zuk	N/A – Control
Demographics	Age	Continuous	Age of patient	N/A – Control
	Gender	Dummy Coded	Gender of the patient: Male or Female	N/A – Control
	Race	Categorical	Race of patient: White, African American, Hispanic, or Other	N/A – Control
	Martial Status	Categorical	Marital Status: Married, Single, Widow, or Divorced	N/A – Control
Social History	Employment Status	Categorical	Employment Status: Full time, Part time, No	N/A – Control
	Alcohol Consumption	Categorical	Patient consumes alcohol: Yes or No	N/A – Control
	Tobacco Use	Dummy Coded	Patient smokes: Yes, No, Former	N/A – Control
	Physical Activity	Dummy Coded	Patient exercises: Yes or No	N/A – Control
Comorbidities	Charlson Index	Continuous	Weighted sum total of the following: 1 point for each decade over 40 years of age. 1 point for Myocardial infarction, Congestive heart failure, Peripheral vascular disease, Cerebrovascular disease, Dementia, Chronic pulmonary disease, Rheumatologic disease, Peptic ulcer disease, or Mild liver disease, Diabetes without chronic complications. 2 points for Diabetes with chronic complications; Hemiplegia or paraplegia, Renal disease; Any malignancy, including	Ordinary Least Squares (OLS) Regression

Variable Category	Variable Name	Measurement Method	Description	Analysis Method
			leukemia and lymphoma; or Moderate or severe liver disease. 6 points for Metastatic solid tumor or AIDS/HIV	
	Cancer	Dummy Coded	Patient has Cancer: Yes or No	Charlson Index
	COPD	Dummy Coded	Patient has COPD: Yes or No	Charlson Index
	Degenerative Disc Disease	Dummy Coded	Patient has Degenerative Disc Disease: Yes or No	Charlson Index
	Diabetes	Dummy Coded	Patient has Diabetes: Yes or No	Charlson Index
	Heart Attack	Dummy Coded	Patient has history of Heart Attack: Yes or No	Charlson Index
	Hepatitis	Dummy Coded	Patient has Hepatitis: Yes or No	Charlson Index
	HIV	Dummy Coded	Patient has HIV: Yes or No	Charlson Index
	Stroke	Dummy Coded	Patient has history of a Stroke: Yes or No	Charlson Index

Note: Data Dictionary located in Appendix B describes how information appeared and how it was attained for the purposes of this study

Table 3. Conceptualized Dependent Variables

Variable Category {SPO Model}	Variable Name	Measurement Method	Description	Analysis Method
Process Time {Process}	Time in ASU/Pre-Op	Continuous	Time from Ambulatory Surgery Unit (ASU)/Pre-Op-in to Ambulatory Surgery Unit (ASU)/Pre-Op-out	Ordinary Least Squares (OLS) Regression
	Surgery Time	Continuous	Time from Surgery Start to Surgery Stop	Ordinary Least Squares (OLS) Regression
	Surgery Preparation Time	Continuous	Time from OR (Operating Room)-in to Surgery Start	Ordinary Least Squares (OLS) Regression
	Surgery	Continuous	Time from Surgery Stop to OR-	Ordinary

Variable Category {SPO Model}	Variable Name	Measurement Method	Description	Analysis Method
	Breakdown Time		Out	Least Squares (OLS) Regression
	Time in OR	Continuous	Time from OR-in to OR-out	Ordinary Least Squares (OLS) Regression
	Time in PACU	Continuous	Time from Post-Anesthesia Care Unit (PACU) in to discharge from Post-Anesthesia Care Unit (PACU)	Ordinary Least Squares (OLS) Regression
	Total Enterprise Throughput Time	Continuous	Total time from Ambulatory Surgery Unit (ASU)/Pre-OP in to discharge from Post-Anesthesia Care Unit (PACU)	Ordinary Least Squares (OLS) Regression
Quality Outcomes {Outcomes}	Post-Operative Infections	Dummy Coded	Post-Operative Infection [positive test result or prophylactic treatment due to: swelling, discharge, redness, hot to touch]: Yes or No, as indicated by EMR and physician notes; by the 3 month follow-up visit	Logistic Regression
	Post-Operative Complications	Dummy Coded	Complications (i.e. revision, pneumonia, bloody drainage, effusion, SVT, swelling, hematoma, incision/drain, neuroma, aspiration –not including post-operative infections and DVT/PE): Yes or No, as indicated by EMR and physician notes; by the 3 month follow-up visit	Logistic Regression
	Non-Surgery Related Complications	Dummy Coded	Non-Surgical Related Complications (i.e. tape reaction, rash, UTI, allergic reaction, bakers cyst, fall, dark stools, muscle cramps): Yes or No, as indicated by EMR and physician notes; by the 3 month follow-up	Logistic Regression
	Deep Vein	Dummy	Deep Vein Thrombosis/	Logistic

Variable Category {SPO Model}	**Variable Name**	**Measurement Method**	**Description**	**Analysis Method**
	Thrombosis/ Pulmonary Embolism	Coded	Pulmonary Embolism [positive test result or prophylactic treatment]: Yes or No, as indicated by EMR and physician notes; by the 3 month follow-up visit	Regression
	Emergency Room Visit	Dummy Coded	Patient visit to the Emergency Room: Yes or No, as indicated by EMR and physician notes; by the 3 month follow-up visit	Logistic Regression
	Hospitalization (Admission / Readmission)	Dummy Coded	Patient admission after outpatient UKA or readmission after inpatient UKA as indicated by EMR and physician notes; by the 3 month follow-up visit	Logistic Regression
	Follow-Up Pain Level	Dummy Coded	Follow-Up Pain that requires physician action outside the normal post-op orders (i.e. injections, stronger pain medicine, increasing dose of pain medication, additional physical therapy, x-ray, CT scan, knee manipulation, brace, etc.): Yes or No, as indicated by EMR and physician notes; by the 3 month follow-up visit	Logistic Regression
	Follow-Up Functional Range of Motion Limitation	Dummy Coded	Functional Range of Motion Limitation, where 125 degrees of flexion is not achieved requiring physician action outside the normal post-op orders (i.e. injections, additional physical therapy knee manipulation, brace, etc.): Yes or No, as indicated by EMR and physician notes; by the 3 month follow-up visit	Logistic Regression
Patient Satisfaction {Outcomes}	Pleased with the Results of UKA	Dummy Coded	Are You Pleased with the Result of the UKA: Yes or No, within three months after UKA, as indicated by EMR and physician notes; by the 3 month follow-up visit	Logistic Regression
	Visual Analog Scale for Patient	Scale	Visual Analog Scale (VAS) for Patient Satisfaction – Scale 0-10	Ordinal Regression

Variable Category {SPO Model}	Variable Name	Measurement Method	Description	Analysis Method
	Satisfaction		[Where 0 is most satisfaction and no discomfort and 10 representing worst satisfaction and discomfort], within three months after UKA, as indicated by EMR and physician notes; by the 3 month follow-up visit	
	Patient Perception of Satisfaction	Dummy Coded	Patient Perception of Satisfaction (i.e. doing well, fantastic, great, good): Yes or No, within three months after UKA, as indicated by EMR and physician notes; by the 3 month follow-up visit	Logistic Regression

Note: Data Dictionary located in Appendix B describes how information appeared and how it was attained for the purposes of this study. Statistical analysis was not conducted on Cost variables, as they are 2012-2014 fiscal year averages of outpatient UKAs compared with inpatient UKAs.

Analytical Method

A cross-sectional comparative evaluation model will be used to compare UKAs in the outpatient setting with UKA in the inpatient setting. The main statistical tool that will be used to study the impact of the setting on Process Time, Quality Outcomes, and Patient Satisfaction is a multiple regression analysis through the use of SPSS statistical software, as seen in Table 4 (Alexopoulos, 2010; Larsen et al., 2012). Ordinary Least Squares (OLS) Regression will be utilized to identify the relationship between continuous dependent variables and independent variables and also to minimize the residuals of standard deviations (Alexopoulos, 2010; Pohlmann & Leitner, 2003). OLS Regression will be utilized for the dependent variable category of Process Time (Midttun & Martinussen, 2005). Logistic Regression will be utilized for categorical and dummy-coded dependent variables in order to estimate the probability of the outcome as a function of the independent variable (Alexopoulos, 2010; Pohlmann & Leitner, 2003). Logistic Regression will be utilized for the following dependent variables: Post-Operative Infections (Momohara et al., 2011; Wu et al., 2014), Post-Operative Complications (Duchman et al., 2014), Non-Surgical Related Complications (Rahmanian et al., 2013), Deep Vein

Thrombosis/Pulmonary Embolism (Miyagi et al., 2007; Zhao et al., 2014), Emergency Room Visits and Hospitalizations (Legrand et al., 2014; Tolomeo, 2009), Follow-Up Pain Level (Singh & Lewallen, 2013; Singh & Lewallen, 2014), Follow-Up Functional Range of Motion Limitation (Heesterbeek, 2011; Singh & Lewallen, 2013), Pleased with the Results of UKA (Lee et al., 2014; Williams et al., 2010), and Patient Perception of Satisfaction (Conner-Spady et al., 2011; Lee et al., 2014). The variables will be analyzed on the patient level. Ordinal Regression will be utilized to measure ordinal scale variables. The Ordinal Regression will be utilized to measure Visual Analog Scale for Satisfaction (Voiosu et al., 2014). The data will be risk-adjusted by utilizing the Charlson Index, which controls for comorbidities (Charlson, Pompei, Ales & MacKenzie, 1987; Charlson, Szatrowski, Peterson, & Gold, 1994; Dias-Santos, Ferrone, Zheng, Lillemoe, & Fernández-Del Castillo, 2015; Jimenez-Garcıa et al., 2011; Singh & Lewallen, 2014; Yang, Chen, Hsu, Chang, & Lee, 2015).

Dr. Kerina's data consists of 400 outpatients and 675 inpatients with dates of service from January 1, 2009 to December 31, 2014. The sample size of 1075 individuals that will be analyzed is the total population of UKA patients seen by the practice generally and this physician particularly from January 1, 2009 to December 31, 2014. Utilizing a sample-size calculation the sample size must be greater than 283, with a 95% confidence level, for a population of 1075 individuals (Sample Size Calculator, n.d.).

Ordinary Least Squares Regression

For OLS Regression the study will report the coefficients that are found to have an alpha of $\leq$ .05 and their standard errors (Miller & Whicker, 1999). The coefficient reported from the analysis represents the slope of the relationship between the independent (Setting of UKA) and the dependent (Process Time) with all other variables held constant. $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i$ where α is the value of Y when all explanatory variables equal zero and β is the average change in Y associated with unit change of X (Hutcheson & Moutinho, 2011). The change in deviance quantifies the impact the different explanatory variables have on Y. The significance on this deviance change can be measured by the F-Statistic.

Logistic Regression

Logistic Regression will be used to analyze dichotomous variables. Statistical significance will be determined with an alpha of ≤ .05. Confounding factors from demographics and patient characteristics can impact Logistic Regression results (Sedgewick, 2014). Odds ratios will be calculated as an estimate of the relative risk because, at times, the relative risk cannot be calculated directly or it is not suited for the study type (Schechtman, 2002). The odds ratio estimates the strength of the impact of confounding variables on the outpatient as compared to the inpatient settings (Sedgewick, 2014). The odds ratio for the setting of the UKA is the relative amount by which the odds of the quality outcomes and/or patient satisfaction increase or decrease when the setting of the UKA changes (by one unit). This translates into the equation that Log-odds = $l_X = a + bx$, where 1_x is the odds for a specific value, x, based on a treatment; where *b m*easures the likelihood of having an improved dependent (i.e. Quality Outcomes and Patient Satisfaction) for a unit change in the independent (Setting of UKA); and where exp(B) measures the changes associated with an improved dependent (i.e. Quality Outcomes and Patient Satisfaction) for a unit change in the independent (setting of UKA) (Wan, 2003).

Charlson Index

Patient characteristics utilizing demographics and the Charlson Index value will measure the extent to which, if any, sicker patients are skewed towards the inpatient setting (Charlson, Pompei, Ales & MacKenzie, 1987). The Charlson Index is one of the most well-known comorbidity indexes. The index assigns point values in order measure a patient's mortality based on comorbidities and age; the higher the score, the higher likelihood of mortality (Beddhu et al., 2000; Dias-Santos et al., 2015; Charlson, Szatrowski, Peterson, & Gold, 1994; Kastner et al., 2006; Singh & Lewallen, 2014; Dias-Santos et al., 2015; Yang et al., 2015).

Ordinal Regression

Ordinal Regression will be utilized for dependent variables that are on an ordinal measurement scale. Ordinal Regression is a generalization of multiple regression and extension of Logistic Regression. Ordinal Regression will be used to analyze the Patient Satisfaction variable of Visual Analog Scale (VAS) for Patient Satisfaction where lower numbers represent better satisfaction, as seen in Appendix G (Voiosu et al., 2014). Ordinary Least Squares Regression cannot be used for continuous variables on an ordinal measurement scale because Ordinary Least Squares Regression requires the dependent variable to be on an interval or ratio scale (Lee et al., 2014).

Table 4. Analysis Methodology in the Literature

Variable Name	Reference	Topic of Study	Method of Measurement
Process Time	Midttun & Martinussen, 2005	Predicting wait times for elective surgeries based on supply and demand side factors for Norwegian hospitals	Ordinary Least Squares Regression was used to determine the relationship of supply and demand side factors on wait times
Post-Operative Infections	Momohara et al., 2011	Identify risk factors of infections before and after total hip and total knee arthroplasty	Logistic Regression was used to analyze patients that were diagnosed or suspected of surgical site infection – Infection or No Infection
	Wu et al., 2014	Identify risk factors of periprosthetic joint infection after total hip and total knee arthroplasty	Logistic Regression was used to calculate the odds ratio of the impact of risk factors on patient infections – Infection or No Infection
Post-Operative Complications	Duchman et al., 2014	Identify risk factors and differences between total and unicompartmental knee arthroplasty	Logistic Regression was used to analyze risk factors of complications rates in patients – Complication or No Complication
Non-Surgery Related Complications	Rahmanian et al., 2013	Analyze the impact and incidence of non-surgical related complications patients who underwent cardiac surgery and the impact on mortality	Logistic Regression was used to calculate post-op mortality – Non-Surgical related complication Yes or No
Deep Vein Thrombosis/ Pulmonary	Miyagi et al., 2007	Determine predictors of Deep Vein Thrombosis (DVT)/Pulmonary	Logistic Regression was used to calculate the odds ratio of incidence of DVT– Positive for

Variable Name	Reference	Topic of Study	Method of Measurement
Embolism		Embolism (PE) after total knee arthroplasty	DVT or Negative for DVT
	Zhao et al., 2014	Identify if diabetes mellitus increases incidence of DVT in total knee arthroplasty patients	Logistic Regression was used calculate the odds ratio of incidence of DVT in Diabetes versus Non-Diabetes Patients of TKA – Positive for DVT or Negative for DVT
Emergency Room Visits	Tolomeo et al., 2009	Identify the significant predictor variables of asthma related Emergency Room Visits	Logistic Regression was used calculate the odds ratio of children having an asthma related Emergency Room Visit
	Legrand et al., 2014	Identifying the predictive value of muscle strength and physical performance on hospitalizations	Logistic Regression was used calculate the odds ratio of hospitalization based on grip strength, short physical battery score, and muscle mass.
Hospitalizations	Tolomeo et al., 2009	Identify the significant predictor variables of asthma related Hospitalizations	Logistic Regression was used calculate the odds ratio of children having an asthma related Hospitalization
Follow-Up Pain Level	Singh & Lewallen, 2013	Identify risk factors of continued pain or functional range of motion limitations of total hip and total knee arthroplasty	Logistic Regression was used to calculate the odds ratio of moderate to serve pain, at follow ups – Yes or No
	Singh & Lewallen, 2014	Predict use of pain medication for continued pain or functional range of motion limitations of total hip and total knee arthroplasty	Logistic Regression was used to predict pain, at follow ups, requiring physician intervention – prescribing NSAIDs and narcotics – Yes or No
Follow-Up Functional Range of Motion Limitation	Heesterbeek, 2011	Identify predictors of range of motion and rotation of patellar tilt and displacement for total knee arthroplasty	Logistic Regression was used to see whether patellar tilt and displacement reached cut off points required – Yes or No
	Singh & Lewallen, 2013	Identify risk factors of continued pain or functional range of motion limitations of total hip and total knee arthroplasty	Logistic Regression was used to calculate the odds ratio of functional range of motion limitations at follow ups requiring – Yes or No
Patient Pleased with Results of UKA	Williams et al., 2010	To identify predictors of satisfaction after total knee arthroplasty	Logistic Regression was used to calculate log odds ratio of satisfaction after 3 months and 12 months of total knee arthroplasty – Yes or No

Variable Name	Reference	Topic of Study	Method of Measurement
Patient Perception of Satisfaction	Conner-Spady et al., 2011	To determine the perception of satisfaction of hip and knee replacements	Logistic Regression was used in this study to build a model for the determinants of satisfaction 3 to 12 months after hip and knee arthroplasty - Yes or No
Charlson Index	Dias-Santos et al. 2015	Utilizing Charlson Index to identify predictors of post-operative mortality for pancreatic cancer	Logistic Regression was used to validate and update the post-operative mortality based on comorbidity, age, and patient demographics
	Singh & Lewallen, 2014	Predict use of pain medication for continued pain or functional range of motion limitations of total hip and total knee arthroplasty	Logistic Regression was used on Charlson Index to calculate the odds ratio of NSAID and narcotic use
Visual Analog Scale for Patient Satisfaction	Voiosu et al., 2014	Measuring acceptable discomfort levels during colonoscopy to improve compliance1 with colonoscopies	Ordinal Regression was utilized to measure the level of comfort and satisfaction of patients that underwent colonoscopies using a 10 point visual analog scale for patient satisfaction with 10 representing worst discomfort and dissatisfaction

Validity

This is a retrospective study of secondary data, which allows specific variables to be chosen that are comparable in both the outpatient and inpatient settings. The variables are collected on all patients in their electronic and paper medical records for reporting purposes. Therefore, the two settings can be compared directly without significant manipulation. As there is a single surgeon performing the UKAs in both settings, the reporting will be the same and the information will also be standardized.

The sample, all UKA patients of Dr. Kerina within the time period previously indicated, has a large amount of cases that should minimize the skew of the data due to outliers. The analysis will be risk-adjusted to minimize channeling bias. Multiple indicators will be used for Process Time, Quality Outcomes and Patient Satisfaction, therefore increasing the triangulation of the study's results.

One issue that will impact the external validity and generalizability of the study is that the sample contains patients from only one physician, and from only one outpatient and one inpatient facility. UKAs are replicable and translatable as it is not a new procedure that is proprietary to one surgeon who invented it. In fact, Dr. Kerina, the physician whose patients are being studied, trains other surgeons on the structure and processes needed to conduct UKAs. At least 100 surgeons trained by Dr. Kerina are currently operating using this method of UKA; therefore, this process is replicable. Although this technique of performing UKAs can be replicated, the focus, in this study, is on Dr. Kerina's practice. This design sacrifices the external validity that might be introduced from the inclusion of other medical practices, thus the generalizability of this study is decreased. However, since only one physician, one outpatient facility, and one inpatient facility are studied, the internal validity is increased because confounders that may exist, due to differences in physician technique, facilities protocols, and regional differences, are not factors.

CHAPTER FOUR: RESULTS

Results

The following chapter will present a statistical analysis of the variables of study for Unicondylar Knee Arthroplasties (UKAs). First, descriptive statistics will be presented, broken down by Setting of the UKA. Thereafter, the chapter is organized by presenting the variable categories as follows: Process Time, Quality Outcomes, and Patient Satisfaction. The statistical tools utilized within these variable categories are: Ordinary Least Squares Regression for continuous dependent variables, Logistic Regression for dichotomous dependent variables, and Ordinal Regression for ordinal scale dependent variables. The Data Dictionary in Appendix B is used as a reference for variable names, reference categories, and the abstracting procedure. Costs are not discussed in the results section as there was insufficient data to conduct a statistical analysis – this will be discussed in the Chapter 5 Discussion, Future Research, and Limitations sections.

Descriptive Statistics

Chi-square tests for association is utilized for categorical variables to determine if there are differences in variables between outpatient and inpatient UKAs.

A chi-square test for association was conducted between Setting and Year of Service. All expected cell frequencies were greater than five. There is a statistically significant association between Setting and Year of Service, as seen in Table 5, X^2 (5) = 135.96, p ≤ .001. The Year of Service breakdown for UKAs, as seen in Table 5, 2009 is 13.5% and 4.3%, 2010 is 15.3% and 2.8%, 2011 is 17.5% and 8.0%, 2012 is 10.0% and 20.3%, 2013 is 21.8% and 28.7%, and 2014 is 22.0% and 28.7% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Knee. Two cells have expected cell frequencies less than five. There is not a statistically significant association between Setting and Knee, as seen in Table 5, X^2 (2) = 3.805, p = .149. The Knee breakdown for UKAs, as seen in Table 5, Left is 53.0% and 48.3%, Right is 47.0% and 51.3%, and Both is 0.0% and 0.4% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Implant. All expected cell frequencies were greater than five. There is a statistically significant association between Setting and Implant, as seen in Table 5, X^2 (1) = 53.013, $p \leq .001$. The Implant breakdown for UKAs, as seen in Table 5, Biomet Oxford is 20.8% and 6.1% and Zimmer Zuk is 79.3% and 93.9% in the outpatient and inpatient setting, respectively.

There is a statistically significant difference in Age between outpatient and inpatient UKAs, as seen in Table 5, t (1073) = -7.35, $p \leq .001$. The mean Age for UKAs as seen in Table 5 is approximately 69 with a standard deviation of 6.66 and 73 with a standard deviation of 8.824 in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Gender. All expected cell frequencies were greater than five. There is not a statistically significant association between Setting and Gender, as seen in Table 5, X^2 (1) = .722, p = .396. The Gender breakdown for UKAs, as seen in Table 5, Males is 48.8% and 46.1% and Females is 51.2% and 53.9% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Race. All expected cell frequencies were greater than five. There is not a statistically significant association between Setting and Race, as seen in Table 5, X^2 (2) = 1.157, p = .561. The Race breakdown for UKAs, as seen in Table 5, Not Specified is 5.3% and 4.3%, White is 93.0% and 93.2%, and African American is 1.8% and 2.5% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Marital Status. Four cells have expected cell frequencies less than five. There is a statistically significant association between Setting and Marital Status, as seen in Table 5, X^2 (5) = 23.443, $p \leq .001$. The Marital Status breakdown for UKAs, as seen in Table 5, Not Specified is 1.0% and 0.1%, Married is 84.0% and 77.9%, Widow is

5.8% and 14.4%, Divorced is 3.0% and 3.1%, Single is 5.8% and 4.1%, and Separated is 0.5% and 0.3% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Employment Status. All expected cell frequencies were greater than five. There is not a statistically significant association between Setting and Employment Status, as seen in Table 5, X^2 (2) = .346, p = .841. The Employment Status breakdown for UKAs, as seen in Table 5, No is 86.0% and 84.7%, Full Time is 7.0% and 7.9%, and Part Time is 7.0% and 7.4% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Alcohol Consumption. All expected cell frequencies were greater than five. There is a statistically significant association between Setting and Alcohol Consumption, as seen in Table 5, X^2 (1) = 18.620, $p \leq .001$. The Alcohol Consumption breakdown for UKAs, as seen in Table 5, No is 53.8% and 67.0% and Yes is 46.3% and 33.0% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Tobacco Use. All expected cell frequencies were greater than five. There is a statistically significant association between Setting and Tobacco Use, as seen in Table 5, X^2 (2) = 21.422, $p \leq .001$. The Tobacco Use breakdown for UKAs, as seen in Table 5, No is 72.5% and 66.8% and Yes is 8.5% and 3.9%, and Former is 19.0% and 29.3% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Physical Activity (regular exercise). All expected cell frequencies were greater than five. There is a statistically significant association between Setting and Physical Activity, as seen in Table 5, X^2 (1) = 7.756, $p \leq .05$. The Physical Activity breakdown for UKAs, as seen in Table 5, No is 51.7% and 60.4% and Yes is 49.3% and 39.6% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Charlson Index. 8 cells have expected counts of less than 5. There is a statistically significant association between Setting and Charlson Index, as seen in Table 5, X^2 (11) = 29.508, $p \leq .05$. Charlson Index breakdown 0.0 is 0.8%

and 0.7%, 1.0 is 0.5% and 0.3%, 2.0 is 0.3% and 0.1%, 4.0 is 3.3% and 3.7%, 5.0 is 2.8% and 1.3%, 6.0 is 48.5% and 37.8%, 7.0 is 23.5% and 25.6%, 8.0 is 13.8% and 15.3%, 9.0 is 6.3% and 10.8%, 10.0 is 0.3% and 3.1%, 11.0 is 0.3% and 1.0%, and 13.0 is 0.0% and 0.1% in the outpatient and inpatient setting, respectively. The average Charlson Index breakdown for UKAs, as seen in Table 5, is approximately 6.55 with a standard deviation of 1.32 and 6.92 for with a standard deviation of 1.53 in the outpatient and inpatient setting, respectively.

Time in the Ambulatory Surgery Unit (ASU)/Pre-Op is measured by calculating the difference from time of entry into ASU/Pre-Op to time of exit from ASU/Pre-Op. As seen in Table 5, the mean Time in ASU/Pre-Op is 92.2 minutes for outpatient UKAs and 150.3 minutes for inpatient UKAs, with standard deviations of 41.55 and 55.28, respectively. The mean Time in ASU/Pre-Op for outpatient UKAs is 57.1 minutes less than the mean Time in ASU/Pre-Op for inpatient UKAs. The difference time shows a large time gap and variation between the two settings.

Time in Surgery Time is calculated by subtracting the Surgery's Start time from the Surgery's End time. As seen in Table 5, the mean Surgery Time is 69.6 minutes for an outpatient UKA and 68.2 minutes for an inpatient UKA, with standard deviations of 18.20 and 17.12, respectively. The mean Surgery Time for inpatient UKAs is 1.4 minutes less than mean Surgery Time for outpatient UKAs. This test shows a small gap time between the two settings.

Surgery Preparation Time is measured by calculating the difference of time from the patient's entry into the Operating Room (OR) until the Surgery Start time. As seen in Table 5, the mean Surgery Preparation Time is 37.5 minutes for the outpatient UKAs and 42.5 minutes for the inpatient UKAs, with standard deviations of 11.61 and 11.07, respectively. The mean Surgery Preparation Time for outpatient UKAs is 5 minutes less than the mean Surgery Preparation Time for inpatient UKAs. This test shows a large time gap between the two settings.

Surgery Breakdown Time is calculated by determining the difference of time from the Surgery End to the patient's exit from Operating Room (OR). As seen in Table 5, the mean Surgery Breakdown

Time is 14.1 minutes for outpatient UKAs and 8.4 minutes for inpatient UKAs, with standard deviations of 10.43 and 5.89, respectively. the mean Surgery Preparation Time for outpatient UKAs is 5.7 minutes more than the mean Surgery Preparation Time for inpatient UKAs. This data shows a time gap between the two settings.

Operating Room time is determined by calculating the difference between the time of entry into Operating Room to the time of exit from Operating Room. As seen in Table 5, the mean Time in Operating Room is 121.2 minutes for outpatient UKAs and 119.2 minutes for inpatient UKAs, with standard deviations of 19.76 and 22.71, respectively. These means show that a small time gap between the two settings does exist. The mean Time in Operating Room for inpatient UKAs is 2 minutes less than the mean Time in Operating Room for outpatient UKAs.

The Time in Post-Anesthesia Care Unit (PACU) is measured by calculating the difference of the time of entry into the PACU from the time of exit from the PACU. As seen in Table 5, the mean Time in PACU is 66.33 minutes for outpatient UKAs and 144.33 minutes for inpatient UKAs, with standard deviations of 28.25 and 74.62, respectively. These numbers show a large time gap and wide variation between the two settings. The mean Time in PACU for outpatient UKAs is 78 minutes less than the mean Time in PACU for inpatient UKAs.

Total Enterprise Throughput Time is calculated by determining the difference between the time of entry into ASU to the time of discharge from PACU. As seen in Table 5, the mean Total Enterprise Throughput Time is 283.5 minutes and 413.8 Minutes for outpatient UKAs and inpatient UKAs, with standard deviations of 53.67 and 96.13, respectively. The mean Total Enterprise Throughput Time for outpatient UKAs is 130.3 minutes less than the mean Total Enterprise Throughput Time for inpatient UKAs. There is thus a large time gap and wide variation between the two settings.

A chi-square test for association was conducted between Setting and Post-Operative Infections. All expected cell frequencies were greater than five. There is not a statistically significant association between Setting and Post-Operative Infections, as seen in Table 5, X^2 (1) = .095, p = .758. The Post-

Operative Infections breakdown for UKAs, as seen in Table 5, No is 97.5% and 97.2% and Yes is 2.5% and 2.8% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Post-Operative Complications. All expected cell frequencies were greater than five. There is not a statistically significant association between Setting and Post-Operative Complications, as seen in Table 5, X^2 (1) = 2.185, p = .139. The Post-Operative Complications breakdown for UKAs, as seen in Table 5, No is 93.3% and 90.7% and Yes is 6.8% and 9.3% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Non-Surgery Related Complications. All expected cell frequencies were greater than five. There is not a statistically significant association between Setting and Non-Surgery Related Complications, as seen in Table 5, X^2 (1) = .227, p = .634. The Non-Surgery Related Complications breakdown for UKAs, as seen in Table 5, No is 89.3% and 88.3% and Yes is 10.8% and 11.7% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Deep Vein Thrombosis/Pulmonary Embolism. All expected cell frequencies were greater than five. There is not a statistically significant association between Setting and Deep Vein Thrombosis/Pulmonary Embolism, as seen in Table 5, X^2 (1) = .058, p = .809. The Deep Vein Thrombosis/Pulmonary Embolism for UKAs, as seen in Table 5, No is 99.3% and 99.1% and Yes is 0.8% and 0.9% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Emergency Room Visits. All expected cell frequencies were greater than five. There is not a statistically significant association between Setting and Emergency Room Visits, as seen in Table 5, X^2 (1) = .450, p = .503. The Emergency Room Visits for UKAs, as seen in Table 5, No is 98.8% and 98.2% and Yes is 1.3% and 1.8% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Hospitalizations. All expected cell frequencies were greater than five. There is not a statistically significant association between Setting and Hospitalizations, as seen in Table 5, X^2 (1) = .346, p = .841. The Hospitalizations for UKAs, as seen in Table 5, No is 98.5% and 97.8% and Yes is 1.5% and 2.2% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Follow-Up Pain. All expected cell frequencies were greater than five. There is not a statistically significant association between Setting and Follow-Up Pain, as seen in Appendix K, X^2 (1) = .075, p = .784. The Follow-Up Pain for UKAs, as seen in Appendix K, No is 87.3% and 86.7% and Yes is 12.8% and 13.3% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Follow-Up Functional Range of Motion Limitation. All expected cell frequencies were greater than five. There is not a statistically significant association between Setting and Follow-Up Functional Range of Motion Limitation, as seen in Table 5, X^2 (1) = 2.376, p = .123. The Follow-Up Functional Range of Motion Limitation for UKAs, as seen in Table 5, No is 97.8% and 96.0% and Yes is 2.3% and 4.0% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Pleased With Results of UKA. All expected cell frequencies were greater than five. There is not a statistically significant association between Setting and Pleased With Results of UKA, as seen in Table 5, X^2 (1) = .015, p = .903. The Pleased With Results of UKA for UKAs, as seen in Table 5, No is 12.3% and 12.0% and Yes is 87.8% and 88.0% in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Visual Analog Scale of Satisfaction. 8 cells have expected count less than 5. There is a statistically significant association between Setting and Visual Analog Scale of Satisfaction, as seen in Table 5, X^2 (10) = 18.670, $p \leq .05$. The Visual Analog Scale of Satisfaction breakdown 0.0 is 47.5% and 33.6%, 1.0 is 18.1% and 20.7%, 2.0 is 13.1% and 16.7%, 3.0 is 6.3% and 9.3%, 4.0 is 3.8% and 6.1%, 5.0 is 7.5% and 5.8%, 6.0 is

0.6% and 3.8%, 7.0 is 1.3% and 0.3%, 8.0 is 1.3% and 1.5%, 9.0 is 0.6% and 0.8%, and 10.0 is 0.0% and 1.5% in the outpatient and inpatient setting, respectively. The average Visual Analog Scale of Satisfaction breakdown for UKAs, as seen in Appendix K, is approximately 1.438 with a standard deviation of 1.96 and 1.939 for with a standard deviation of 2.23 in the outpatient and inpatient setting, respectively.

A chi-square test for association was conducted between Setting and Patient Perception of Satisfaction. All expected cell frequencies were greater than five. There is a statistically significant association between Setting and Patient Perception of Satisfaction, as seen in Table 5, X^2 (1) = 120.022, p ≤ 001. The Patient Perception of Satisfaction for UKAs, as seen in Table 5, No is 18.8% and 28.6%, Yes is 36.5% and 56.9%, and Missing is 44.8% and 14.5% in the outpatient and inpatient setting, respectively.

Table 5. Descriptive Statistics

Variable Category	**Variable**	**Pearson Chi-Square**			**Attribute**	**Measurement**	**Setting**		
		Value	**df**	**Sig**			**Outpatient N = 400**	**Inpatient N = 675**	**Total N = 1075**
Surgery Related	Year of Service	135.96	5	.000	2009	Count	54	29	83
						% within Set.	13.5%	4.3%	7.7%
					2010	Count	61	19	80
						% within Set.	15.3%	2.8%	7.4%
					2011	Count	70	54	124
						% within Set.	17.5%	8.0%	11.5%
					2012	Count	40	137	177
						% within Set.	10.0%	20.3%	16.5%
					2013	Count	87	194	281
						% within Set.	21.8%	28.7%	26.1%
					2014	Count	88	242	330
						% within Set.	22.0%	35.9%	30.7%
	Knee	3.805	2	.149	Left	Count	212	326	538
						% within Set.	53.0%	48.3%	50.0%
					Right	Count	188	346	534
						% within Set.	47.0%	51.3%	49.7%
					Both	Count	0	3	3
						% within Set.	0.0%	0.4%	0.3%

Variable Category	Variable	Pearson Chi-Square Value	df	Sig	Attribute	Measurement	Setting: Outpatient N = 400	Inpatient N = 675	Total N = 1075
	Implant	53.013	1	.000	Biomet Oxford	Count	83	41	124
						% within Set.	20.8%	6.1%	11.5%
					Zimmer Zuk	Count	317	634	951
						% within Set.	79.3%	93.9%	88.5%
Demo-graphics	Age					Mean	69.313	73.06	
						Std. Dev.	6.6657	8.824	
	Gender	.722	1	.396	Male	Count	195	311	506
						% within Set.	48.8%	46.1%	47.1%
					Female	Count	205	364	569
						% within Set.	51.2%	53.9%	52.9%
	Race	1.157	2	.561	Not Specified	Count	21	29	50
						% within Set.	5.3%	4.3%	4.7%
					White	Count	372	629	1001
						% within Set.	93.0%	93.2%	93.1%
					African American	Count	7	17	24
						% within Set.	1.8%	2.5%	2.2%
	Marital Status	23.443	5	.000	Not Specified	Count	4	1	5
						% within Set.	1.0%	0.1%	0.5%
					Married	Count	336	526	862
						% within Set.	84.0%	77.9%	80.2%
					Widow	Count	23	97	120
						% within Set.	5.8%	14.4%	11.2%
					Divorced	Count	12	21	33
						% within Set.	3.0%	3.1%	3.1%
					Single	Count	23	28	51
						% within Set.	5.8%	4.1%	4.7%
					Separated	Count	2	2	4
						% within Set.	0.5%	0.3%	0.4%
Social History	Employment Status	.346	2	.841	No	Count	344	572	916
						% within Set.	86.0%	84.7%	85.2%
					Full Time	Count	28	53	81
						% within Set.	7.0%	7.9%	7.5%
					Part Time	Count	28	50	78
						% within Set.	7.0%	7.4%	7.3%
	Alcohol Consumption	18.620	1	.000	No	Count	215	452	667
						% within Set.	53.8%	67.0%	62.0%
					Yes	Count	185	223	408
						% within Set.	46.3%	33.0%	38.0%
	Tobacco Use	21.422	2	.000	No	Count	290	451	741
						% within Set.	72.5%	66.8%	68.9%
					Yes	Count	34	26	60
						% within Set.	8.5%	3.9%	5.6%

Variable Category	Variable	Pearson Chi-Square			Attribute	Measurement	Setting		
		Value	df	Sig			Outpatient N = 400	Inpatient N = 675	Total N = 1075
					Former	Count	76	198	274
						% within Set.	19.0%	29.3%	25.5%
	Physical Activity	7.756	1	.005	No	Count	207	408	615
						% within Set.	51.7%	60.4%	57.2%
					Yes	Count	193	267	460
						% within Set.	48.3%	39.6%	42.8%
Comorbid-ities	Charlson Index	29.508	11	.002	0	Count	3	5	8
						% within Set.	0.8%	0.7%	0.7%
					1	Count	2	2	4
						% within Set.	0.5%	0.3%	0.4%
					2	Count	1	1	2
						% within Set.	0.3%	0.1%	0.2%
					4	Count	13	25	38
						% within Set.	3.3%	3.7%	3.5%
					5	Count	11	9	20
						% within Set.	2.8%	1.3%	1.9%
					6	Count	194	255	449
						% within Set.	48.5%	37.8%	41.8%
					7	Count	94	173	267
						% within Set.	23.5%	25.6%	24.8%
					8	Count	55	103	158
						% within Set.	13.8%	15.3%	14.7%
					9	Count	25	73	98
						% within Set.	6.3%	10.8%	9.1%
					10	Count	1	21	22
						% within Set.	0.3%	3.1%	2.0%
					11	Count	1	7	8
						% within Set.	0.3%	1.0%	0.7%
					13	Count	0	1	1
						% within Set.	0.0%	0.1%	0.1%
						Mean	6.55	6.92	
						Std. Dev.	1.32	1.53	
Process Time	Time in ASU/Pre-OP					Mean	93.2	150.3	
						Std. Dev.	41.55	55.28	
	Surgery Time					Mean	69.64	68.21	
						Std. Dev.	18.2	17.12	
	Surgery Preparation					Mean	37.47	42.555	
						Std. Dev.	11.61	11.07	
	Surgery Breakdown Time					Mean	14.11	8.42	
						Std. Dev.	10.43	5.89	
	Time in OR					Mean	121.22	119.18	

Variable Category	Variable	Pearson Chi-Square Value	df	Sig	Attribute	Measurement	Setting Outpatient N = 400	Inpatient N = 675	Total N = 1075
						Std. Dev.	19.76	22.71	
	Time in PACU					Mean	66.33	144.3	
						Std. Dev.	28.25	74.62	
	Total Enterprise Throughput Time					Mean	283.47	413.81	
						Std. Dev.	53.67	96.13	
Quality Outcomes	Post-Operative Infections	.095	1	.758	No	Count	390	656	1046
						% within Set.	97.5%	97.2%	97.3%
					Yes	Count	10	19	29
						% within Set.	2.5%	2.8%	2.7%
	Post-Operative Complications	2.185	1	.139	No	Count	373	612	985
						% within Set.	93.3%	90.7%	91.6%
					Yes	Count	27	63	90
						% within Set.	6.8%	9.3%	8.4%
	Non-Surgery Related Complications	.227	1	.634	No	Count	357	596	953
						% within Set.	89.3%	88.3%	88.7%
					Yes	Count	43	79	122
						% within Set.	10.8%	11.7%	11.3%
	Deep Vein Thrombosis/ Pulmonary Embolism	.058	1	.809	No	Count	397	669	1066
						% within Set.	99.3%	99.1%	99.2%
					Yes	Count	3	6	9
						% within Set.	0.8%	0.9%	0.8%
	Emergency Room Visits	.450	1	.503	No	Count	395	663	1058
						% within Set.	98.8%	98.2%	98.4%
					Yes	Count	5	12	17
						% within Set.	1.3%	1.8%	1.6%
	Hospitalization (Admitted / Readmitted)	.684	1	.408	No	Count	394	660	1054
						% within Set.	98.5%	97.8%	98.0%
					Yes	Count	6	15	21
						% within Set.	1.5%	2.2%	2.0%
	Follow-Up Pain	.075	1	.784	No	Count	349	585	934
						% within Set.	87.3%	86.7%	86.9%
					Yes	Count	51	90	141
						% within Set.	12.8%	13.3%	13.1%
	Follow-Up Functional Range of Motion Limitation	2.376	1	.123	No	Count	391	648	1039
						% within Set.	97.8%	96.0%	96.7%
					Yes	Count	9	27	36
						% within Set.	2.3%	4.0%	3.3%
Patient Satisfaction	Pleased With Results of UKA	.015	1	.903	No	Count	49	81	130
						% within Set.	12.3%	12.0%	12.1%
					Yes	Count	351	594	945

Variable Category	Variable	Pearson Chi-Square Value	df	Sig	Attribute	Measurement	Setting: Outpatient N = 400	Inpatient N = 675	Total N = 1075
						% within Set.	87.8%	88.0%	87.9%
	Visual Analog Scale of Satisfaction						Outpatient N = 160	Inpatient N = 396	Total N = 556
		18.670	10	.045	.0	Count	76	133	209
						% within Set.	47.5%	33.6%	37.6%
					1.0	Count	29	82	111
						% within Set.	18.1%	20.7%	20.0%
					2.0	Count	21	66	87
						% within Set.	13.1%	16.7%	15.6%
					3.0	Count	10	37	47
						% within Set.	6.3%	9.3%	8.5%
					4.0	Count	6	24	30
						% within Set.	3.8%	6.1%	5.4%
					5.0	Count	12	23	35
						% within Set.	7.5%	5.8%	6.3%
					6.0	Count	1	15	16
						% within Set.	0.6%	3.8%	2.9%
					7.0	Count	2	1	3
						% within Set.	1.3%	0.3%	0.5%
					8.0	Count	2	6	8
						% within Set.	1.3%	1.5%	1.4%
					9.0	Count	1	3	4
						% within Set.	0.6%	0.8%	0.7%
					10.0	Count	0	6	6
						% within Set.	0.0%	1.5%	1.1%
						Mean	1.438	1.939	
						Std. Dev.	1.960	2.230	
	Patient Perception of Satisfaction						Outpatient N = 221	Inpatient N = 577	Total N = 791
		120.022	2	.000	No	Count	75	193	268
						% within Set.	18.8%	28.6%	24.9%
					Yes	Count	146	384	530
						% within Set.	36.5%	56.9%	49.3%

Regression Analysis

Process Time

Process Time data is attained through calculating the difference between time of entry and time of exit for each time variable, which is then converted into minutes. Each process time variable is analyzed by the use of Ordinary Least Squares Regression. All of the process time variables are statistically significant as it relates to the setting that a UKA is performed. The issue as presented is that there are large time gaps in the inpatient that an approximately one hour greater, which are causing delays for entry into the OR, the preparation of a patient once they arrive in the ASU/Pre-Op, and their discharge after surgery. If a UKA is performed in the inpatient setting the following increases over the outpatient setting are noted: forty-nine minutes to Time in ASU/Pre-Op, five minutes to Surgery Time, six and a half minutes to Surgery Preparation Time, six minutes to Time in Operating Room, seventy-eight minutes to Time in PACU, and 129 minutes to Total Enterprise Throughput Time. If a UKA is performed in the outpatient setting it would add approximately five minutes to Surgery Breakdown Time. The each phase of the surgery other than Surgery Breakdown Time would be less in the outpatient setting. Any delays in Process Time relating to UKAs in the outpatient setting would not be related to the surgery and, in fact, are out of the surgeon's control.

Table 6. Process Time Regression Summary

Variable	**Adjusted R Square**	**Model**			**Setting**		
		df	**F**	**Sig**	**Beta**	**t**	**Sig**
Time in Ambulatory Surgery Unit/Pre-Op	.304	25	19.759	**.000**	48.96	14.246	**.000**
Surgery Time	.278	25	17.55	**.000**	5.05	4.739	**.000**
Surgery Preparation Time	.102	25	5.872	**.000**	6.47	8.284	**.000**
Surgery Breakdown Time	.109	25	6.281	**.000**	-5.84	-10.373	**.000**
Time in Operating Room	.273	25	17.120	**.000**	5.68	4.295	**.000**
Time in Post-Anesthesia Care Unit	.301	25	19.472	**.000**	78.02	18.076	**.000**
Total Enterprise Throughput Time	.384	25	27.757	**.000**	128.73	22.034	**.000**

Time in Ambulatory Surgery Unit/Pre-Op

Ordinary Least Squares Regression is utilized to determine if the Time in Ambulatory Surgery Unit (ASU)/Pre-Op for UKAs performed in the outpatient setting is significantly different from UKAs performed in the inpatient setting. This regression is run to determine if the setting of a UKA can statistically predict Time In ASU/Pre-Op. There is an independence of residuals, as assessed by a

Durbin-Watson statistic, of 1.758 (Table 6). The assumptions of linearity, independence of errors, homoscedasticity, unusual points, and normality of residuals were met. The model is statistically significant, F (25, 1049) = 19.759, $p \leq .001$, adj. $R^2 = .304$. Setting statistically significantly predicts Time in ASU/Pre-Op Regression, as seen in Table 6, $\beta = 48.96$, $t = 14.246$, $p \leq .001$. The beta explains that if a UKA is performed in the inpatient setting it would add approximately 49 minutes to Time in ASU/Pre-Op. Regression coefficients and standard errors can be found in Appendix H.

Surgery Time

Ordinary Least Squares Regression is utilized to determine if the Surgery Time for UKAs performed in the outpatient setting is significantly different from UKAs performed in the inpatient setting. This regression is run to determine if the setting of a UKA can statistically predict Surgery Time. There is an independence of residuals, as assessed by a Durbin-Watson statistic, of 17.553, (Table 6). The assumptions of linearity, independence of errors, homoscedasticity, unusual points, and normality of residuals were met. The model is statistically significant, F (25, 1049) = 17.55, $p \leq .001$, adj. $R^2 = .278$. Setting statistically significantly predicts Surgery Time, as seen in Table 6, $\beta = 5.05$, $t = 4.739$, $p \leq .001$. The beta explains that if a UKA is performed in the inpatient setting it would add approximately 5 minutes to Surgery Time. Regression coefficients and standard errors can be found in Appendix H.

Surgery Preparation Time

Ordinary Least Squares Regression is utilized to determine if the Surgery Preparation Time for UKAs performed in the outpatient setting is significantly different from UKAs performed in the inpatient setting. This regression is run to determine if the setting of a UKA can statistically predict Surgery Preparation Time. There is an independence of residuals, as assessed by a Durbin-Watson statistic, of 1.892 (Table 6). The assumptions of linearity, independence of errors, homoscedasticity, unusual points, and normality of residuals were met. The model is statistically significant, F (25, 1049) = 5.872, $p \leq .001$, adj. $R^2 = .102$. Setting statistically significantly predicts Surgery Preparation Time, as seen in Table 6, β = 6.47, t = 8.284, $p \leq .001$. The beta explains that if a UKA is performed in the inpatient setting it would add approximately 6.5 minutes to Surgery Preparation Time. Regression coefficients and standard errors can be found in Appendix H.

Surgery Breakdown Time

Ordinary Least Squares Regression is utilized to determine if the Surgery Breakdown Time for UKAs performed in the outpatient setting is significantly different from UKAs performed in the inpatient setting. This regression is run to determine if the setting of a UKA can statistically predict Surgery Breakdown Time. There is an independence of residuals, as assessed by a Durbin-Watson statistic, of 1.816 (Table 6). The assumptions of linearity, independence of errors, homoscedasticity, unusual points, and normality of residuals were met. The model is statistically significant, F (25, 1049) = 6.281, $p \leq .001$, adj. $R^2 = .109$. Setting statistically significantly predicts Surgery Breakdown Time, as seen in Table 6, β = -5.84, t = -10.373, $p \leq .001$. The beta explains that if a UKA is performed in the outpatient setting it would add approximately 6 minutes to Surgery Breakdown Time. Regression coefficients and standard errors can be found in Appendix H.

Time in Operating Room

Ordinary Least Squares Regression is utilized to determine if the Time in Operating Room for UKAs performed in the outpatient setting is significantly different from UKAs performed in the inpatient setting. This regression is run to determine if the setting of a UKA can statistically predict Time in Operating Room. There is an independence of residuals, as assessed by a Durbin-Watson statistic, of 1.794 (Table 6). The assumptions of linearity, independence of errors, homoscedasticity, unusual points, and normality of residuals were met. The model is statistically significant, F (25, 1049) = 17.120, $p \leq .001$, adj. $R^2 = .273$. Setting statistically significantly predicts Time in Operating Room, as seen in Table 6, β = 5.68, t = 4.295, $p \leq .001$. The beta explains that if a UKA is performed in the inpatient setting it would add approximately 6 minutes to Time in Operating Room. Regression coefficients and standard errors can be found in Appendix H.

Time in Post-Anesthesia Care Unit

Ordinary Least Squares Regression is utilized to determine that if the Time in Post-Anesthesia Care Unit (PACU) for UKAs performed in the outpatient setting is significantly different from UKAs performed in the inpatient setting. This regression is run to determine if the setting of a UKA can statistically predict Time in PACU. There is an independence of residuals, as assessed by a Durbin-Watson statistic, of 1.868 (Table 6). The assumptions of linearity, independence of errors, homoscedasticity, unusual points, and normality of residuals were met. The model is statistically significant, $F\ (25, 1049) = 19.472$, $p \leq .001$, adj. $R^2 = .301$. Setting statistically significantly predicts Time in PACU, as seen in Table 6, $\beta = 78.02$, $t = 18.076$, $p \leq .001$. The beta explains that if a UKA is performed in the inpatient setting it would add approximately 78 minutes to Time PACU. Regression coefficients and standard errors can be found in Appendix H.

Total Enterprise Throughput Time

Ordinary Least Squares Regression is utilized to determine if the Total Enterprise Throughput Time for UKAs performed in the outpatient setting is significantly different from UKAs performed in the inpatient setting. This regression is run to determine if the setting of a UKA can statistically predict Total Enterprise Throughput Time. There is an independence of residuals, as assessed by a Durbin-Watson statistic, of 1.798 (Table 6). The assumptions of linearity, independence of errors, homoscedasticity, unusual points, and normality of residuals were met. The model is statistically significant, $F\ (25, 1049) = 27.757$, $p \leq .001$, adj. $R^2 = .384$. Setting statistically significantly predicts Total Enterprise Time, as seen in Table 6, $\beta = 128.73$, $t = 22.034$, $p \leq .001$. The beta explains that if a UKA is performed in the inpatient setting it would add approximately 129 minutes to Total Enterprise Throughput Time. Regression coefficients and standard errors can be found in Appendix H.

Quality Outcomes

The Quality Outcomes variables for UKAs are measured by multiple clinical indicators, all of which have varying statistical significance. Patients who undergo UKAs in the outpatient setting have a lower chance of Non-Surgery Related Complications, Follow-Up Pain, Follow-Up Functional Range of Motion Limitation, all to a statistically significant degree. There is a lower chance of Post-Operative Complications, Emergency Room Visits, and Hospitalizations for UKAs performed in the outpatient setting, but not to a statistically significant degree. There is a higher chance of Post-Operative Infections and Deep Vein Thrombosis/Pulmonary Embolism for UKAS performed in the outpatient setting, but not to a statistically significant degree.

Table 7. Quality Outcomes Regression Summary

Variable	**Nagelkerke R Square**	**Exp(B)**	**Chi-Sqaure**	**df**	**Sig**
Post-Operative Infections	.094	.910 (1.09)	22.403	25	.612
Post-Operative Complications	.051	1.558	24.135	25	.512
Non-Surgery Related Complications	.074	1.278	40.900	25	**.024**
Deep Vein Thrombosis/Pulmonary Embolism	.306	.705 (1.42)	30.764	25	.197
Emergency Room Visits	.194	1.085	31.825	25	.163
Hospitalization (Admitted / Readmitted)	.113	1.025	21.400	25	.670
Follow-Up Pain	.077	1.318	45.579	25	**.007**
Follow-Up Functional Range of Motion Limitation	.183	1.336	51.977	25	**.001**

Post-Operative Infections

A Logistic Regression is performed to ascertain the effects of Setting on the likelihood that patients develop Post-Operative Infections. The Logistic Regression model is not statistically significant, as seen in Table 7, X^2 (25) = 22.403, p = .612. The model explained 9.4% (Nagelkerke R^2) of the variance in Post-Operative Infections and correctly classified 97.3% of cases, as seen in Appendix H. Sensitivity is 0%, specificity is 100%, positive predictive value is 0%, and negative predictive value is 97.30%. Of the thirty-one predictor variables, none are statistically significant (Appendix H). Outpatient UKA patients have 1.09 times higher odds of Post-Operative Infections than inpatient UKA patients. Although there is a statistically significant difference, the effect size of the noted log odds is small. Undergoing a UKA in the inpatient setting is associated with a reduction in the likelihood of Post-Operative Infections.

Post-Operative Complications

A Logistic Regression is performed to ascertain the effects of Setting on the likelihood of patients developing Post-Operative Complications. The Logistic Regression model is not statistically significant, as seen in Table 7, $X^2(25) = 24.135$, $p = .512$. The model explained 5.1% (Nagelkerke R^2) of the variance in Post-Operative Complications and correctly classified 91.6% of cases, as seen in Appendix H. Sensitivity is 0%, specificity is 100%, positive predictive value is 0%, and negative predictive value is 91.6%. Of the thirty-one predictor variables, African American was the only statistically other significant variable, as shown in Appendix H. Inpatient UKA patients have 1.558 times higher odds of Post-Operative Complications than outpatient UKA patients. Undergoing a UKA in the outpatient setting is associated with a reduction in the likelihood of Post-Operative Complications.

Non-Surgery Related Complications

A Logistic Regression is performed to ascertain the effects of Setting on the likelihood that patients develop Non-Surgery Related Complications. The Logistic Regression model is statistically significant, as seen in Table 7, $X^2(25) = 40.900$ $p \leq .05$. The model explained 7.4% (Nagelkerke R^2) of the variance in Non-Surgery Related Complications and correctly classified 88.7% of cases, as seen in Appendix H. Sensitivity is .8%, specificity is 100%, positive predictive value is 100%, and negative predictive value is 88.73%. Of the thirty-one predictor variables, Single, Full Time, and Tobacco Use Former are the only other statistically significant variables (Appendix H). Inpatient UKA patients have 1.278 times higher odds of Non-Surgery Related Complications than outpatient UKA patients. Undergoing a UKA in the outpatient setting is associated with a reduction in the likelihood of Non-Surgery Related Complications.

Deep Vein Thrombosis/Pulmonary Embolism

A Logistic Regression is performed to ascertain the effects of Setting on the likelihood that patients develop Deep Vein Thrombosis/Pulmonary Embolism. The Logistic Regression model is not statistically significant, which can be seen in Table 7, X^2 (25) = 30.764, p = .197. The model explained 31.3% (Nagelkerke R^2) of the variance in Deep Vein Thrombosis/Pulmonary Embolism and correctly classified 99.2% of cases, as seen in Appendix H. Sensitivity is 0%, specificity is 100%, positive predictive value is 0%, and negative predictive value is 99.16%. Of the thirty-one predictor variables, Year of Service 2011 is the only other statistically significant variable, as shown in Appendix H. Outpatient UKA patients have 1.42 times higher odds of Deep Vein Thrombosis/Pulmonary Embolism than inpatient UKA patients. Undergoing a UKA in the inpatient setting is associated with a reduction in the likelihood of Deep Vein Thrombosis/Pulmonary Embolism.

Emergency Room Visits

A Logistic Regression is performed to ascertain the effects of Setting on the likelihood that patients require Emergency Room Visits. The Logistic Regression model is not statistically significant, as seen in Table 7, X^2 (25) = 31.825, p = .163. The model explained 19.4% (Nagelkerke R^2) of the variance in Emergency Room Visits and correctly classified 98.4% of cases, as seen in Appendix H. Sensitivity is 0%, specificity is 100%, positive predictive value is 0%, and negative predictive value is 98.41%. Of the thirty-one predictor variables, Tobacco Use Yes and Tobacco Use Former are the only other statistically significant variables (Appendix H). Inpatient UKA patients have 1.085 times higher odds of requiring Emergency Room Visits than outpatient UKA patients. Undergoing a UKA in the outpatient setting is associated with a reduction in the likelihood of Emergency Room Visits.

Hospitalizations

A Logistic Regression is performed to ascertain the effects of Setting on the likelihood that patients require Hospitalizations. The Logistic Regression model is not statistically significant, as seen in Table 7, X^2 (25) = 21.400, p = .670. The model explained 11.3% (Nagelkerke R^2) of the variance in Hospitalizations and correctly classified 98% of cases, as seen in Appendix H. Sensitivity is 0%, specificity is 100%, positive predictive value is 0%, and negative predictive value is 98.05%. Of the thirty-one predictor variables, none were statistically significant, as shown in Appendix H. Inpatient UKA patients have 1.025 times higher odds of requiring Hospitalizations than outpatient UKA patients. Undergoing a UKA in the outpatient setting is associated with a reduction in the likelihood of Hospitalizations.

Follow-Up Pain

A Logistic Regression is performed to ascertain the effects of Setting on the likelihood that patients have Follow-Up Pain. The Logistic Regression model is statistically significant, as seen in Appendix H, X^2 (25) = 45.579, $p \leq .05$. The model explained 7.7% (Nagelkerke R^2) of the variance in Follow-Up Pain and correctly classified 86.9% of cases, as seen in Appendix H. Sensitivity is 1.4%, specificity is 99.8%, positive predictive value is 50%, and negative predictive value is 87.03%. Of the thirty-one predictor variables, Female and African American, are the only other statistically significant variables (Appendix H). Inpatient UKA patients have 1.318 times higher odds of Follow-Up Pain than outpatient UKA patients. Undergoing a UKA in the outpatient setting is associated with a reduction in the likelihood of Follow-Up Pain.

Follow-Up Functional Range of Motion Limitation

A Logistic Regression is performed to ascertain the effects of Setting on the likelihood that patients have Follow-Up Functional Range of Motion Limitation. The Logistic Regression model is statistically significant, as seen in Table 7, X^2 (25) = 51.977, $p \leq .001$. The model explained 18.6% (Nagelkerke R^2) of the variance in Follow-Up Functional Range of Motion Limitation and correctly classified 96.6% of cases as seen in Appendix H. Sensitivity is 0%, specificity is 99.9%, positive predictive value is 100% and negative predictive value is 96.65%. Of the thirty-one predictors variables, Female, African American, and Alcohol Consumption are the only other statistically significant variables, as shown in Appendix H. Inpatient UKA patients have 1.336 times higher odds of Follow-Up Functional Range of Motion Limitation than outpatient UKA patients. Having a UKA in the outpatient setting is associated with a reduction in the likelihood of Follow-Up Functional Range of

Motion Limitation.

Patient Satisfaction

The Patient Satisfaction for UKAs performed in the outpatient and inpatient settings varied between the different measures. The Patient Satisfaction variables describe different aspects of the patient's experience with a UKA. Pleased with the Results of UKA ties directly to the patient's view of the success of their surgery. The Visual Analog Scale for Patient Satisfaction ties their satisfaction to a number that can be measured. Patient Perception of Satisfaction identifies if the patient's experience of undergoing the UKA, as well as the post-operative care met their expectations and they are satisfied. UKA patients in the outpatient setting are more likely to be Pleased with the Results of UKA, to a statistically significant degree. The Visual Analog Scale for Patient Satisfaction for UKA patients in the outpatient setting is lower (lower meaning more satisfied) than it is for UKA patients in the inpatient setting, to a statistically significant degree. Patients undergoing UKAs in the inpatient setting are more likely to have higher Patient Perception of Satisfaction, to a statistically significant degree.

Table 8. Patient Satisfaction Regression Summary

Variable	**Nagelkerke R Square**	**Exp(B)**	**Chi-Sqaure**	**df**	**Sig**
Pleased with the Results of UKA	.085	.994 (1.006)	48.525	25	**.003**
Visual Analog Scale for Patient Satisfaction	N/A	.534 (1.87)	11.599	1	**.001**
Patient Perception of Satisfaction	.173	1.007	106.351	22	**.000**

Pleased with the Results of UKA

A Logistic Regression is performed to ascertain the effects of Setting on the likelihood that patients are Pleased with the Results of their UKA. The Logistic Regression model is statistically significant, as seen in Table 8, X^2 (25) = 48.525, $p \leq .05$. The model explained 8.5% (Nagelkerke R^2) of the variance in Pleased with the Results of UKA and correctly classified 88.1% of cases, as seen in Appendix H. Sensitivity is 99.9%, specificity is 2.3%, positive predictive value is 84.21%, and negative predictive value is 75%. Of the thirty-one predictor variables, Year of Service 2010, Year of Service

2012, Divorced and Separated are the only other statistically significant variables, as shown in Appendix H. Inpatient UKA patients have 1.006 times higher odds of not being Pleased with the Results of UKA than outpatient UKA patients. Despite a statistically significant difference, the effect size of the noted log odds is small. Undergoing a UKA in the inpatient setting is associated with a reduction, in the likelihood of Pleased with the Results of UKA.

Visual Analog Scale of Satisfaction

A cumulative odds Ordinal Regression with proportional odds is run to determine the effect of the UKA Setting on the Visual Analog Scale for Patient Satisfaction, as seen in Appendix H. The deviance goodness-of-fit test indicated that the model is a good fit to the observed data, X^2 (5400) = 1936.212, p = 1.000, as seen in Appendix H. The Pearson goodness-of-fit test indicated that the model is a good fit to the observed data, X^2 (5400) = 5078.368, p = .999, as seen in Appendix H. The final model did statistically significantly predict the Visual Analog Scale for the Patient Satisfaction variable over and above the intercept-only model: X^2 (20) = 31.993, $p \leq .05$, as seen in Appendix H. The general model is a not significantly better fit to the data than the ordinal model: X^2 (180) = 167.896, p = .732, as seen in Appendix H. The odds-ratio-of-being of having a higher Visual Analog Scale for the Satisfaction for inpatient versus outpatient UKAs, is 1.87 (95% CI, .372 to .766), which is a statistically significant effect: X^2 (1) = 11.599, $p \leq .001$, as seen in Table 8. Note that the Visual Analog Scale for Patient Satisfaction is a subset of the total population of the study as it was, which was collected from March 1, 2013 - December 31, 2014, with outpatients N = 160 and inpatients N = 396.

Patient Perception of Satisfaction

A Logistic Regression is performed to ascertain the effects of Setting on the likelihood that patients have Patient Perception of Satisfaction. The Logistic Regression model is statistically significant, as seen in Table 8, X^2 (22) = 106.351, $p \leq .001$. The model explained 17.3% (Nagelkerke R^2) of the variance in Patient Perception of Satisfaction and correctly classified 69.7% of cases, as seen in Appendix H. Sensitivity is 86.8%, specificity is 35.8%, positive predictive value is 49.4%, and negative predictive value is 57.8%. Of the thirty-one predictor variables, Year of Service 2012, Year of Service 2013, and Female, are the other statistically significant variables, as shown in Appendix H. Inpatient UKA patients have 1.007 times higher odds of exhibiting Patient Perception of Satisfaction than outpatient UKA patients. Although there is a statistically significant difference, the practical impact is expected to be small . Undergoing a UKA in the outpatient setting is associated with a reduction in the likelihood of Patient Perception of Satisfaction of UKA. Note that Patient Perception of Satisfaction is a subset of the total population of the study as it was collected from December 1, 2011 - December 31, 2014, with outpatients N = 221 and inpatients N = 577.

Hypothesis Testing Results

The purpose of the study is to compare outpatient UKAs with inpatient UKAs based on variables that were structured on Donabedian's Structure, Process, and Outcomes model. These summarized results of the regression analysis can be found in Table 9 for the variable categories of Process Time, Quality Outcomes, and Patient Satisfaction. Table 9 identifies if hypothesis is supported and if there is statistically significant difference between outpatient UKAs and inpatient UKAs for the variable identified in the hypothesis.

Table 9. Results of Hypothesis Testing

Alternate Hypothesis	Hypothesis Supported?	Comment
Ha_1: The Time in ASU/Pre-Op of UKAs performed in the outpatient setting is less than the Time in ASU/Pre-Op of UKAs performed in the inpatient setting.	Yes, Reject the Null	If a UKA is performed in the inpatient setting it would add approximately 49 minutes to Time in ASU/Pre-Op, to a statistically significant degree, $p \leq .001$.
Ha_2: The Surgery Time of UKAs performed in the outpatient setting is less than the Surgery Time of UKAs performed in the inpatient setting.	Yes, Reject the Null	If a UKA is performed in the inpatient setting it would add approximately 5 minutes to Surgery Time, to a statistically significant degree, $p \leq .001$.
Ha_3: The Surgery Preparation Time of UKAs performed in the outpatient setting is less than the Surgery Preparation Time of UKAs performed in the inpatient setting.	Yes, Reject the Null	If a UKA is performed in the inpatient setting it would add approximately 6.5 minutes to Surgery Preparation Time, to a statistically significant degree, $p \leq .001$.
Ha_4: The Surgery Breakdown Time of UKAs performed in the outpatient setting	No, But Reject the	If a UKA is performed in the outpatient setting it would add approximately 6

Alternate Hypothesis	Hypothesis Supported?	Comment
is less than the Surgery Breakdown Time UKAs performed in the inpatient setting.	Null	minutes to Surgery Breakdown Time, to a statistically significant degree, $p \leq .001$.
Ha_5: The Time in Operating Room of UKAs performed in the outpatient setting is less than the Time in Operating Room of UKAs performed in the inpatient setting.	Yes, Reject the Null	If a UKA is performed in the inpatient setting it would add approximately 6 minutes to Time in Operating Room, to a statistically significant degree, $p \leq .001$.
Ha_6: The Time in the Post-Anesthesia Care Unit of UKAs performed in the outpatient setting is less than the Time in the Post-Anesthesia Care Unit of UKAs performed in the inpatient setting.	Yes, Reject the Null	If a UKA is performed in the inpatient setting it would add approximately 78 minutes to Time PACU, to a statistically significant degree, $p \leq .001$.
Ha_7: The Total Enterprise Throughput Time of UKAs performed in the outpatient setting is less than the Total Enterprise Throughput Time of UKAs performed in the inpatient setting.	Yes, Reject the Null	If a UKA is performed in the inpatient setting it would add approximately 129 minutes to Total Enterprise Throughput Time, to a statistically significant degree, $p \leq .001$.
Ha_8: Post-Operative Infections of UKAs performed in the outpatient setting are fewer than Post-Operative Infections of UKAs performed in the inpatient setting.	No, Fail to Reject the Null	Outpatients have a 1.08 higher chance of more Post-Operative Infections than inpatients, but not to a statistically significant degree, $p = .603$.
Ha_9: Post-Operative Complications (not including post-operative infections and DVT/PE) of UKAs performed in the outpatient setting are fewer than Post-Operative Complications (not including post-operative infections and DVT/PE) of UKAs performed in the inpatient setting.	No, Fail to Reject the Null	Inpatients have a 1.561 higher chance of more Post-Operative Complications than outpatients, but not to a statistically significant degree, $p = .603$.
Ha_{10}: Non-Surgery Related Complications of UKAs performed in the outpatient setting are fewer than Non-Surgery Related Complications of UKAs performed in the inpatient setting.	Yes, Reject the Null	Inpatients have a 1.284 higher chance of more Non-Surgery Related Complications than outpatients, to a statistically significant degree, $p \leq .05$.
Ha_{11}: Deep Vein Thrombosis/Pulmonary Embolisms following UKAs performed in the outpatient setting are fewer than Deep Vein Thrombosis/Pulmonary Embolism of UKAs performed in the inpatient setting.	No, Fail to Reject the Null	Outpatients have a 1.34 higher chance of more Deep Vein Thrombosis/Pulmonary Embolisms than inpatients, but not to a statistically significant degree, $p = .174$.
Ha_{12}: Emergency Room Visits following UKAs performed in the outpatient setting are fewer than Emergency Room Visits following UKAs performed in the inpatient setting.	No, Fail to Reject the Null	Inpatients have a 1.091 higher chance of more Emergency Room Visits than outpatients, but not to a statistically significant degree, $p = .165$.
Ha_{13}: Hospitalizations (Admission/Readmission) following UKAs performed in the outpatient setting are fewer than Hospitalizations	No, Fail to Reject the Null	Inpatients have a 1.024 higher chance of more Hospitalizations than outpatients, but not to a statistically significant degree, $p = .675$.

Alternate Hypothesis	Hypothesis Supported?	Comment
(Admission/Readmission) following UKAs performed in the inpatient setting.		
Ha_{14}: Follow-Up Pain for UKAs performed in the outpatient setting is less than Follow-Up for UKAs performed in the inpatient setting.	Yes, Reject the Null	Inpatients have a 1.320 higher chance of more Follow-Up Pain than outpatients, to a statistically significant degree, $p \leq .05$.
Ha_{15}: Follow-Up Functional Range of Motion Limitation for UKAs performed in the outpatient setting is greater than Follow-Up Functional Range of Motion Limitation for UKAs performed in the inpatient setting.	Yes, Reject the Null	Inpatients have a 1.342 higher chance of more Follow-Up Functional Range of Motion Limitation than outpatients, to a statistically significant degree, $p \leq .05$.
Ha_{16}: The Pleased with the Results of UKA for UKAs performed in the outpatient setting is higher than the Pleased with the Results of UKA for UKAs performed in the inpatient setting.	Yes, Reject the Null	Outpatients have a 1.006 higher chance of being more Pleased with the Results of UKA than inpatients, to a statistically significant degree, $p \leq .05$.
Ha_{17}: The Visual Analog Scale for Patient Satisfaction for UKAs performed in the outpatient setting is lower than the Visual Analog Scale for Patient Satisfaction for UKAs performed in the inpatient setting.	Yes, Reject the Null	Outpatients have a 1.87 higher chance of lower Visual Analog Scale for Patient Satisfaction than inpatients, to a statistically significant degree, $p \leq .001$.
Ha_{18}: Patient Perception of Satisfaction for UKAs performed in the outpatient setting is higher than Patient Perception of Satisfaction for UKAs performed in the inpatient setting.	No, But Reject the Null	Inpatients have a 1.007 higher chance of higher Patient Perception of Satisfaction than inpatients, to a statistically significant degree, $p \leq .001$.

Note: Statistical analysis was not conducted on Cost variables, as they are 2012-2014 fiscal year averages of outpatient UKAs compared with inpatient UKAs.

CHAPTER FIVE: CONCLUSIONS, LIMITATIONS, DISCUSSION, AND FUTURE RESEARCH

Study Conclusions

The theoretical approach for this study shows a way forward with procedure-by-procedure method by which procedures can be analyzed. The theoretical framework was based on the area of management known as Organizational Science. Organizational Science was used to guide the comparison of outpatient UKAs with inpatient UKAs. This allows various theories and tools to be utilized to guide the analysis. Managing the transition to outpatient UKAs requires healthcare organizations to use an approach based on Organizational Science that will successfully change their paradigm to outpatient-centered care. Contingency Theory, which stems from Organizational Science, illustrates how organizations adapt their structures and processes to the environmental context, such as the movement of transitioning to outpatient UKAs. Organizational Performance Theory guides the response to the transition to outpatient UKAs by describing how the organization's structure and processes determines the outcomes it generates. These theories lead to Donabedian's Structure, Process, and Outcomes model where the independent variable of study, the setting of a UKA, is the Structure. Reengineering completes the framework, so that organizations can utilize principles of continuous improvement and implementation of best practices from the external environment, and the information from the structure and processes, to improve the outcomes. For the dependent variables of study, the Process is measured by the Process Time, and the Outcomes are measured by Quality Outcomes and Patient Satisfaction. The positive impacts on Process Time variables such as Total Enterprise Throughput promotes the idea that Donabedian's model in fact does apply Organizational Performance Theory by utilizing the changes to the setting of the procedure, as well as the processes, in reducing the time of the various phases of a UKA. Contingency Theory shows outcomes generated by the Affordable Care Act and other reforms emphasizing that organizations transitioning to outpatient UKAs are adapting and changing their processes. Reengineering can be utilized as a continuous improvement tool to take these findings, such as the reduction of Follow-Up Pain and Follow-Up Functional Range of Motion, to focus the structure and processes of an organization, to produce even better outcomes. The findings support the overall framework as well as the core analysis utilizing Donabedian's SPO model that can be translated into other procedures, system-wide, and internationally.

After comparing outpatient UKAs with inpatient UKAs, the results showed differences, some of them statistically significant, with respect to Process Time, Quality Outcomes, and Patient Satisfaction. No study conclusions will be presented for the Cost variables as there was insufficient data for statistical analysis. The theory and literature suggested that the UKAs performed in the outpatient setting could show some improvements over the inpatient setting, and this study adds to the literature.

In fact, all of the Process Time variables were statistically significant. Process Time was less for outpatient UKAs for all phases of the procedure, with the exception of Surgery Breakdown Time, which was approximately 6 minutes higher than in the inpatient setting. Inefficiencies occur when the patient is held at the facility, both before and after surgery. The inefficiencies that were found in the Process Time can have costs associated with them. These include the potential costs incurred of having a patient in the ASU and PACU receiving care as well as the opportunity cost of taking space of other potential patients. Inefficiencies are fewer in the outpatient setting as related to Time in ASU/Pre-Op, Surgery Time, Surgery Preparation Time, Time in Operating Room, Time in PACU, and Total Enterprise Throughput Time. The average variation in how long a patient will stay in the ASU or PACU is similar from outpatient to inpatient. However, in some cases, inpatients took 4-6 hours in the ASU or PACU, which translated, at times, into a Total Throughput Time of 13 hours. These differences increase the chances of exposure to factors that can negatively impact Quality Outcomes and Patient Satisfaction. The Process Time component of Donabedian's SPO model can be utilized to further reengineer the time necessary in the various stages of a UKA. Using medical advances as well as adapting to the external pressure of increasing competition, the Process Time can be evaluated to illustrate how organizations are modifying their processes to adapt to the external environmental context. Organizational Performance Theory explains how the change in the setting of the UKA, or the structure, impacts the process, in this case, the Process Time.

Quality Outcomes, with the exception of Post-Operative Infections and Deep Vein Thrombosis/Pulmonary Embolism – of which both were not statistically significant - all favored the outpatient setting. Non-Surgery Related Complications, Follow-Up Pain, and Follow-Up Functional Range of Motion Limitation were less for outpatient UKAs, to a statistically significant degree. Although some of the Quality Outcomes were not statistically significant, the fact is that they are very similar or have a positive leaning trend to the outpatient setting, which shows the viability of outpatient UKAs. UKA patients have similar if not better Outcomes in the outpatient setting as compared with the inpatient setting. Although it was not analyzed in the study, negative Quality Outcomes do have costs associated with them, as seen in the literature. Post-Operative Complications, Emergency Room Visits and Hospitalizations were less for outpatient UKAs, but not to a statistically significant degree. These events have high costs associated with them. Going to the emergency room or being admitted to the hospital can lead to negative quality outcomes and patient satisfaction. Therefore, less incidence of Hospitalizations and Emergency Room Visits for outpatient UKAs have wide ranging impacts. This translates back into the theoretical framework developed. The outcomes produced are related to the changes in the structure and processes as described in Organization Performance Theory. This internal dynamic of the organization is a direct result of the external environmental context as explained by Contingency Theory. The results found regarding Quality Outcomes can inform an organization internally utilizing Donabedian's SPO model in conjunction with reengineering to continuously improve the quality outcomes produced by modifying the structure and processes.

Patient Satisfaction had mixed results for UKAs performed in the outpatient setting, all to a statistically significant degree. Patients undergoing UKAs in the outpatient setting had a higher chance of being more Pleased with the Results of UKA than inpatients, to a statistically significant degree.

With a more standardized approach, the Visual Analog Scale for Patient Satisfaction, outpatient UKAs had higher chance of lower (being more satisfied), to a statistically significant degree. However, patients undergoing UKAs in the inpatient setting had a higher chance of positive Patient Perception of Satisfaction than in the outpatient setting, to a statistically significant degree. Patient Satisfaction is impacted by other factors such as the Quality Outcomes. Quality Outcomes issues can negatively impact the experience that patients have during or after a UKA. If patients are inconvenienced with having to go for additional visits, have more invasive treatments to mitigate quality issues, or have to go for emergency room or be admitted to the hospital, each one of these factors can lead to more negative Patient Satisfaction. These Patient Satisfaction results show the importance of utilizing a theory guided framework. Contingency Theory explains the emphasis of quality and patient satisfaction that are now required for reimbursements under the Affordable Care Act. Organizations are adapting their structure and processes to accommodate this new reality. These changes to the structure and processes generate the outcomes of positive changes to Patient Satisfaction as can be explained by Organizational Performance Theory. Although the core of the analysis is centered around Donabedian's SPO model, this can be translated into the greater theory. Additionally, these results of improvements of Patient Satisfaction can inform organizations on how to modify their structure and processes further through reengineering.

The following section will include the limitations, discussion, and future research possibilities related to comparing UKAs in outpatient setting and the UKAs in the inpatient setting. The implications of the study will be discussed and expanded upon, thus adding to the previously-limited literature. Additionally, limitations of the study – both ones that were known prior to the study and ones that were discovered as a consequence of the data analysis and their results – will be presented. Furthermore, these research proceedings can be utilized as starting foundations for future research, specifically regarding the transition of other procedures to the outpatient setting.

Limitations

A major limitation in the study was the analysis of the costs. Data was not made available on the individual patient level for the inpatient setting. The data available for the inpatient setting were average numbers for Gross Charges, Direct Costs, and Revenue collected from fiscal years 2012-2014. On the other hand, the outpatient cost information that was collected, was on the patient-unit level and was unique, unlike the fiscal year averages that were provided for the inpatient cost data. Therefore, this information was not included in the results and conclusion sections of the document as the data could not be analyzed using statistical methods. This limited data from the inpatient side narrowed the range of statistical analysis that could be employed because the two assumptions – normally distributed variables and little multicollinearity – were broken. Although there are limitations from a statistical standpoint, it is important to note that the clinical and administrative use of costs, even if they are averages, still provides important information.

Another limitation is that the study is dependent on data available from electronic medical records and reports provided by Dr. J. Mandume Kerina. The fact that the study only analyzes one physician's patients may limit the external validity and generalizability of the study to other physicians and facilities, however it is common that in the beginning of a transition to the outpatient setting that one clinician has the majority of the patient base. There is also a chance of data bias, especially with respect to patient satisfaction and comorbidities from the practice. However, the use of one physician's data, both for the outpatient and inpatient setting, minimizes issues of provider and operative consistency. This in turn strengthens the internal validity as the techniques of performing a UKA are essentially the same. Another limitation comes from the data collection. Data was abstracted from the EMR, which resulted in researcher making decisions about scores for some variables. In other words, some variables were not directly collected and interpretations were required. The study was risk-adjusted by utilizing the Charlson Index. The Charlson Index is an objective measure that was used to control for potential confounders and selection biases due to demographic and comorbidity characteristics of patients in the outpatient and inpatient settings.

Since this study is retrospective and cross-sectional in nature, there is also a limit to the conclusions that can be drawn. Cross-sectional analysis only allows for a snapshot in time. The study could not measure the changes over time of specific techniques. Cross-sectional analysis is limiting because it may not be able to capture occurrences of implant failure, rare instances of complications, or other data points that depend on time as a variable, since it does not track the results of each follow-up appointment, the nuances in the changes of outcomes, or long term patient satisfaction. Only a longitudinal analysis would be able to capture results such as outcomes and satisfaction over time.

Another limitation specifically relates to the regression analyses in this research. One of the main points of this study is that correlation does not imply causality. Thus, the results generated can only show that there are correlations between the variables, but no causality can be claimed. The type of regression utilized in this study measures the interaction between one independent variable and one dependent variable. This type of analysis does not measure the interaction between the setting (the independent variable) and the interactions between multiple dependent variables simultaneously. One alternative analytical tool is Structural Equation Modeling, which can be utilized to measure the interaction between different dependent variables.

Another limitation of this study is the difference in the size of the groups. The inpatient setting has 1.69 times more patients – at 675 patients – than the outpatient setting – at 400 patients. This can cause issues relating to the significance as well as the directionality of the results. Due to this data composition, there are also limitations on two of the Patient Satisfaction variables: the Visual Analog Scale for Patient Satisfaction and the Patient Perception of Satisfaction, which are both subsets of the whole population. The Visual Analog Scale for Patient Satisfaction was not consistently administered until March 1, 2013. Patient Perception of Satisfaction was not consistently administered until December 1, 2011. Since these two Patient Satisfaction variables have missing data for earlier cases, there are obvious limits to the conclusions that can be made about the population.

Study Discussion

Findings

Process Time

Patients having a UKA in the inpatient setting will, on average, spend approximately forty-nine minutes more in the ASU/Pre-Op than their outpatient counterparts, to a statistically significant degree. Inpatients are waiting longer in bed, hooked up to IVs, vital signs monitors, and oxygen, waiting to be taken to the operating room. Besides the time factor, patients are taking up space and resources that can be used for other patients scheduled for surgery that day. As this time increases, a backlog of patients waiting for surgery in the ASU/Pre-Op causes more strain on the system. Patients will move from the ASU/Pre-Op to the operating room.

Patients having a UKA in the inpatient setting will have approximately five minutes more Surgery Time than their outpatient counterparts, to a statistically significant degree. Surgery Time represents the time from surgeon incision to time of closure of the surgery site. UKAs in the two settings generally utilize the same surgical technique and the same set of standard operating procedures of performing surgeries, however the inpatient setting will have a longer process time. The UKA standard operating procedure involves the removal of the damaged tissue. Multiple measurements are taken throughout the surgery using guides and sizing pieces for the different components of the implant.

Patients having a UKA in the inpatient setting will have approximately six minutes more Surgery Preparation Time than their outpatient counterparts. Surgery Preparation Time represents the time in which it takes a patient from their entrance into the operating room to incision time. This time difference shows that prior to the incision time patients are spending more time in the inpatient setting as compared to the outpatient setting. Although there is an average time difference of six minutes for outpatient UKAs, small modifications to reduce the start time of the UKA have had an impact. During this Surgery Preparation Time patients are positioned into a tourniquet, the surgery area is cleansed, and surgery drapes are put on the patient. After the surgery preparation is completed, patients will begin surgery.

Patients having a UKA in the inpatient setting will have approximately six minutes less of Surgery Breakdown Time than their outpatient counterparts. The Surgery Breakdown Time represents the time from surgery end to the time a patient leaves the operating room to be placed in the PACU. The small average time difference of Surgery Breakdown Time shows that both settings are very similar to one another. During this time, nurses in the PACU are notified and the area is prepped for patient arrival. The patient will be moved out of the operating room once the PACU is ready to accept the patient.

Patients having a UKA in the inpatient setting will spend approximately six minutes more Time in Operating Room than their outpatient counterparts. Time in Operating Room represents the total time from entry into the operating room to exit to the PACU. Time in Operating Room is broken down into the Surgery Preparation Time, Surgery Time, and Surgery Breakdown Time. The time in which a patient spends in the operating room shows that the protocols that are specific to performing UKAs are similar in both the outpatient and inpatient settings.

Patients having a UKA in the inpatient setting will spend approximately 78 minutes more Time in PACU than their outpatient counterparts. This additional time means that inpatients continue to receive intravenous medications, as well as vital signs monitoring in bed waiting to be admitted to the floor. In other words, not only do the outpatients spend approximately one hour less in the PACU, they also are discharged to home. The inpatients are spending more time in the discharge process and will end up being admitted either way. The time needed for the room on the floor to be prepared and the staffing to be arranged to accept the patient after discharge from PACU can explain this large time gap.

Patients having a UKA in the inpatient setting will have approximately 129 minutes more Total Enterprise Throughput Time than their outpatient counterparts. Total Enterprise Throughput represents the time from patient entry into the ASU/Pre-Op until their discharge from the PACU - to the floor for inpatients and back home for outpatients. The large time difference that is illustrated by the Total Enterprise Throughput time shows, that on average, UKAs performed in the outpatient setting have drastic time savings.

Quality Outcomes

UKA patients have a 1.09 higher chance of more Post-Operative Infections than in the inpatient setting, but not statistically significant degree. The lack of significance as well as the relatively small effect size shows that both outpatient and inpatient Post-Operative Infections are similar. To identify Post-Operative Infections after a UKA the clinician identifies whether there is drainage, warmth of the surgery site, redness, swelling, or if a test result of the wound site comes back positive. Post-Operative Infections in these cases are treated with oral or intravenous antibiotics, incision and drain, or debridement. Infections require the involvement of the surgeon and require follow up until the issue is resolved.

UKA patients in the inpatient setting have a 1.558 times higher chance of more Post-Operative Complications than UKA patients in the outpatient setting, but not to a statistically significant degree. Although Post-Operative Complications were not statistically significant, patients having UKAs in the outpatient setting have a lower risk of Post-Operative Complications than patients in the inpatient setting. These Post-Operative Complications have to do directly with the UKA procedure itself. Examples of these Post-Operative Complications involve implant issues, loose cement, and effusion. These complications require direct action from the surgeon such as implant revision, incision and drain, debridement, Revision UKA, or conversion to Total Knee Arthroplasty. These issues necessitate follow up with the surgeon until these issues are resolved. Post-Operative Complications do not include Post-Operative Infections or Deep Vein Thrombosis/Pulmonary Embolism.

Inpatient UKA patients have a 1.278 higher chance of more Non-Surgery Related Complications than outpatient UKA patients, to a statistically significant degree. Non-Surgery Related Complications captures complications that are indirectly related to the UKA. This is created to identify what complications are inherent to the procedure itself and what falls outside the purview of the UKA. These include allergic reactions, rashes, cramping, urinary tract infections, and blood in stool. Many of these incidents do not require direct action from the surgeon and can be treated by other clinicians. Non-Surgery Related Complications do not include Post-Operative Complications, Post-Operative Infections, or Deep Vein Thrombosis/Pulmonary Embolism.

Outpatients having UKAs have a 1.42 times higher chance of more Deep Vein Thrombosis/Pulmonary Embolism than inpatients having UKAs, but not to a statistically significant degree. Since these are very rare events the ratio here is deceptive due to the fact that only three Deep Vein Thrombosis/Pulmonary Embolism occurred in the outpatient setting and six in the inpatient setting. Deep Vein Thrombosis/Pulmonary Embolism are very serious cases that require admission to the hospital, immediate surgeon action, and continued follow up.

Inpatients undergoing UKAs are 1.085 times more likely to require Emergency Room Visits as compared with outpatients, but not to a statistically significant degree. Although not statistically significant, the number of Emergency Room Visits for UKAs are less in the outpatient setting as compared with the inpatient setting. No patients in either setting had multiple Emergency Room Visits related to the their UKA. Emergency Room Visits are a rare events for UKAs, so the statistical difference between the two settings is difficult to measure. This means that issues after UKA that prompt Emergency Room Visits are less in the outpatient setting as compared with the inpatient setting. These Emergency Room Visits open patients to further complications.

The chance of Hospitalization is 1.025 times more likely for UKAs in the inpatient setting as compared with UKAs in the outpatient setting, but not to a statistically significant degree. Although not statistically significant, the incidence of Hospitalizations for UKAs is less in the outpatient setting as compared with the inpatient setting. Similar to Emergency Room Visits, Hospitalizations are rare events for UKAs and therefore impact the statistical significance. No patients in either setting had multiple Hospitalizations related to the their UKA. This means that the reasons behind admission or readmission to the hospital are less in the outpatient setting. The events that give rise to Hospitalizations are more severe than those that require Emergency Room visits.

Inpatients are 1.318 times more likely of Follow-Up Pain for UKAs as compared with outpatients, to a statistically significant degree. This difference is significant and points to inpatients having more issues with pain that requires surgeon action. What drives a patient to undergo a UKA primarily is pain they are experiencing, which makes Follow-Up Pain a tangible measure of success or failure. Patients with Follow-Up Pain require more or stronger pain medication, injectable pain medication, manipulation under anesthesia, or extended physical therapy. Therefore, if patients after a UKA are still experiencing pain at follow-up visits that is not controlled by the regimen established by the surgeon, then this is a serious issue that must be resolved. In some extreme cases, ongoing Follow-Up Pain issues require revision of UKA or conversion to Total Knee Arthroplasty.

Inpatients are 1.336 times more likely of higher Follow-Up Functional Range of Motion Limitation than their outpatient counterparts, to a statistically significant degree. Follow-Up Functional Range of Motion Limitation is another important factor, as it is another major reason of undergoing a UKA. This is due to the limited activities that patients are able to perform due to their knee related issues. Patients look towards Follow-Up Functional Range of Motion Limitation as being another tangible measure of UKA success. Ongoing Follow-Up Functional Range of Motion Limitation require direct surgeon action and follow up. Continued Follow-Up Functional Range of Motion Limitation require extended physical therapy, change to physical therapy regimen, or manipulation under anesthesia. In some extreme cases, ongoing Follow-Up Functional Range of Motion Limitation require revision of UKA or conversion to Total Knee Arthroplasty.

Patient Satisfaction

Inpatients are 1.006 times more likely of not being Pleased with the Results of UKA as compared with outpatients, to a statistically significant degree. This effect size is small, but it does show that for the satisfaction directly related to the results of their UKA, patients in the outpatient setting are more pleased. The importance of this measure is that the patient perception of the results of the UKA is measured rather than just an overall satisfaction found the other Patient Satisfaction measures. This Patient Satisfaction measure was collected from the beginning of the study period, January 01, 2009.The importance of this measure is that the patient perception of the results of the UKA is measured rather than just an overall satisfaction found the other Patient Satisfaction measures.

Outpatients are 1.89 times more likely of lower score in the Visual Analog Scale for Patient Satisfaction than their inpatient counterparts, to a statistically significant degree. This lower score for outpatients means they are more satisfied and comfortable. Although the Visual Analog Scale for Patient Satisfaction was only available for a subset of the total patients, it is still very instructive in the measuring Patient Satisfaction. The Visual Analog Scale is used as more objective measure of overall Patient Satisfaction. Because satisfaction is a very subjective matter, having more triangulation assists in encompassing the many factors that can impact Patient Satisfaction.

Inpatients are 1.007 times more likely of higher Patient Perception of Satisfaction than their outpatient counterparts, to a statistically significant degree. The effect size found is relatively small. This Patient Satisfaction measure collected was before the Visual Analog Scale for Patient Satisfaction began being collected. Rather than just identifying the satisfaction of the results of the UKA, this measures the perception of satisfaction of patients. Because patients express their satisfaction in different ways, Patient Perception of Satisfaction is able to capture a more subjective side of satisfaction.

Transitioning Procedures to the Outpatient Setting

Overall, other studies conducted up to this point lacked analysis based on procedures transitioning to the outpatient setting. This study utilizes an integrated approach that analyzes process time, quality outcomes, and patient satisfaction based on Donabedian’s Structure, Process, and Outcomes model. Most, if not all, surgical procedures were originally performed in an inpatient setting due to the lack medical techniques, level of technology support, safety, concerns and the ease of centralization of resources. In the inpatient setting contingencies were in place in case there were any types of complications during surgical procedures. However, with improvements in the field of medicine and safety, surgical procedures could be performed outside of the inpatient setting safely. With outpatient services, hospitals were able to save on costs, due to less invasive procedures and reduced dependency on inpatient resources. With the outpatient setting as a viable option, patients are discharged for recovery to their homes, instead of being admitted to the hospital. Nevertheless, given the wide variation in how procedures are performed and the supportive care that procedures require, transitioning to the outpatient setting is not a simple task that can be done on a large scale, especially given the current systems in place. Similarly, comparing performance measures of procedures across settings is not something that can be done on a wide scale. Each procedure must be evaluated individually to identify how its intricate details are impacted by a move from the inpatient to the outpatient setting.

Although the healthcare system will benefit from this study, a procedure-by-procedure approach will be needed to reveal the intricacies of the process time, quality outcomes, and patient satisfaction before a more widespread policy of transitioning procedures to the outpatient setting can be created. That step is necessary mainly due to the lack of wide-scale data that might offer direct comparisons for transitioning to the outpatient setting. Thus, the comparison of outpatient UKAs with inpatient UKAs functions as a stepping-stone in supporting an evidence-based approach to contrasting different procedures and treatments in both the outpatient and inpatient settings and across different variables. This study can be used as a platform for different national and international systems to transition their procedures to the outpatient setting.

Outpatient Unicondylar Knee Arthroplasty

What makes UKAs the starting point in this study can also be a limitation of UKAs, as discussed in the limitations section. UKAs in the outpatient setting are relatively new to the practice of medicine and, therefore, the data that compares outpatient UKAs to inpatient UKAs is subsequently limited. The newness of the procedure is one of the reasons why only one physician's patient population over a six-year period was utilized for this study. The physician is, however, a pioneer in the field. Additionally, the transition of UKAs to the outpatient setting is in its beginning stages and therefore comparisons of the two settings can still be made. This is unlike other surgeries that have fully transitioned to the outpatient setting, such as cataract surgery in the United States, where inpatient data would be rare.

UKAs are an apt choice for this study since it will become a more common surgery due to an ever-aging population that requires knee replacements. There are other potential benefits that UKAs offer. For example, in countries where Total Knee Arthroplasties (TKAs) are prohibitively expensive, or the post-operative care and rehabilitation is not available, UKAs could potentially become more common, especially in the outpatient setting. As UKAs become more common, this study could be repeated in order to analyze other physicians' surgeries in the outpatient and inpatient settings.

The outpatient setting has been important in developing and testing new techniques to improve care. Since physicians that work in freestanding facilities have more discretion and flexibility, they can develop and refine these techniques over time. Furthermore, physicians have more say in the policies and procedures that are used for surgeries in the outpatient setting, which allows for refinements of their techniques. These new techniques range from taking different X-Ray views, injecting pain medications into the tissue around the joint, requiring patients to walk the day of surgery, and participation in active physical therapy after surgery. The refinement process takes place overtime, since there is an incentive for better outcomes and greater efficiency. Moreover, because many surgeons are partial owners in outpatient surgical facilities, cost reductions, higher volume, and greater satisfaction directly benefits the patients as well as the physician.

Indeed, UKAs performed in the outpatient settings have allowed Dr. Kerina to develop the following concrete goals for the success of the surgery: resurface the damaged compartment, correct the alignment, and balance the ligaments. He also developed a set of outcomes that patients undergoing knee surgery want to know: if they will survive the procedure, if they will reach a functional level after surviving the procedure, how fast they will get to a higher functional level without complications, and how long they will stay there at that higher functional level.

Theoretical Implications

In general, it can be very difficult to operationalize a broad and globally-useful framework of quality and patient satisfaction due to its abstract nature and the lack of concrete evidence that can be applied system-wide (Williams, 2010). The framework utilized in this study was based around Organizational Science and more specifically Contingency Theory; Organizational Performance Theory; Donabedian’s Structure, Process, and Outcomes model; and reengineering. This framework was used to guide the analysis of UKAs in regards to Process Time, Quality Outcomes, and Patient Satisfaction. Operationalizing a large concept can be very complex and arduous, one must start with a rationale that is more grounded. It is less complicated to begin with data that is well defined and easily available. Once this is accomplished, the task of operationalizing a greater theory can take place (Quality vs. Costs, 2000). In developing a theoretical framework, it can be helpful to start with measures that are already being utilized. Analyzing and contrasting these indicators across different settings will strengthen the foundation for a broad, overarching framework and theory that can then be applied nationally and internationally (Martens, Akin, Maud, & Mohsin, 2010). A framework and theory that is grounded on evidence-based practices will have greater validity and generalizability, increasing its impact in the settings where it will be applied.

The findings within the study exemplify how the theoretical framework presented with Donabedian’s SPO model as a core can be utilized to measure the transition of procedures to the outpatient setting. This procedure-by-procedure analysis is within the context of health reform and external pressures. Contingency Theory explains how organizations can adapt to these external realities. With this in mind, organizations will change their structure and processes based on the environmental context. By changing the structure, the setting of the procedure, and processes, measured in the study by process time, Organizational Performance Theory links these changes to the outcomes produced. The outcomes produced here are the Quality Outcomes and Patient Satisfaction. Reengineering allows for a continuous feedback loop so that once the outcomes are generated, the structure and processes can be modified to further improve the outcomes. Additionally, as the environmental context changes, such as competition and changes in practice, organizations will further modify their structure and processes utilizing reengineering to produce positive outcomes.

Policy Implications

Prior research has mainly focused on addressing process time, costs, quality outcomes, and patient satisfaction as separate paradigms. Wide-scale cross-sectional studies have not taken place to evaluate if transitioning inpatient surgical procedures to the outpatient setting is feasible. This is particularly true when analyzing the transition of UKAs from the inpatient to the outpatient setting. Rather, the literature has mainly centered on aggregate or very narrow discussions of outpatient UKAs. Furthermore, other research is special-interest based or only analyzes one setting, both of which are very narrow in nature. A comprehensive and systematic approach must be used to analyze surgical procedures based on multiple indicators, including process time, costs, quality outcomes, and patient satisfaction between the outpatient and inpatient settings (Fulton, Lasdon, McDaniel, & Coppola, 2008).

A practical approach to Donabedian's Structure, Process, and Outcomes model is utilizing benchmarking techniques so that organizations can emulate how others have transitioned to outpatient UKAs. Benchmarking provides information on the structure and processes of organizations that have successfully decreased process time, reduced costs, improved quality outcomes, and improved patient satisfaction based on their transition to outpatient UKAs. Rather than blindly making changes to the structure and processes to transition to outpatient UKAs, organizations have the ability to customize the transition to outpatient UKAs in an informed manner. This ability to customize the process allows healthcare systems to find the best way to transition to outpatient UKAs that fits their needs based on the examples of successful organizations.

Barriers to Obtaining Data

Although the patients' data was housed an Electronic Medical Record (EMR), the full potential of the EMR system and informatics were not utilized. The main reason behind this issue is that EMR systems that were implemented in these facilities are still limited to the same functionality of a paper charts and are not taking advantage of the opportunities afforded to them by using an electronic system. EMR systems in development should incorporate more data mining tools to allow for deeper insight into patient populations and further analysis of current practices. However, the current utilization ignores the benefits of the electronic format when it comes to conducting quality- and process-improvement studies in order to eventually realize cost-saving opportunities. Most of these systems are built to store information, and bill accurately. The large potential for gathering outcomes, patient satisfaction, and other information is wasted because due to the data input methods, informatics is reduced to information management, or the collection, storage, and transfer of information, rather than the analysis of data and to aid in decision making. In addition, many organizations, facilities, payers, and providers have different systems that are incompatible and so cannot be interfaced with one another. However, with correct utilization and analysis of information in narrative and unstructured format, the data can be elevated – as was done in this study.

There is a clear divide between the practice of medicine and the researchers who are using large data sets, like the CMS, does not allow for real-time, on-the-ground changes to the standards of care. These divisions result in greater barriers for healthcare organizations and researchers who want to access real-time data, thus increasing the time and cost of research and analysis of current healthcare trends. The need to lower these barriers is a motivation for improving the healthcare system in the United States, with far-reaching implications that span well beyond the confines of this particular study.

However, barriers to obtaining data are not limited to EMR systems. The hospital involved in this particular study, like all hospitals around the nation, had its own set of policies and procedures to navigate in order to obtain patient data. This barrier is difficult to overcome due to the inherent laws and ethics that govern how a patient's health data is stored and managed. In other words, the data needed to conduct analysis to change policies, change standards of practice, and make improvements to the system as a whole are hard to obtain and even harder to analyze. Decision-making is hampered because evidence-based approaches are difficult to produce. The result of these challenges is that the practice of medicine only changes by reimbursement policies, by mandatory standard of practice changes, or by pioneering physicians, like Dr. Kerina.

As mentioned in the limitations section above, the cost data is one of the most impacted fields when it comes to these proprietary information claims. Since there are negotiated contracts, hospitals and other institutions do not want this information made available to outside parties. In this study's case, the hospital was willing to work with Dr. Kerina on some aspects of cost information; however, they were unable/unwilling to produce detailed patient level cost information. They stated that their system does not tabulate specific costs on the patient-unit-level. Therefore, the hospital was only willing and able to produce fiscal year average numbers for 2012-2014 for the cost information.

Technically, hospitals, particularly community hospitals, do not exist to do research; they exist to care for patients. However, it is important that hospitals have good data mining tools to help guide their use of resources toward that end (patient care). EMR systems should have integrated data mining tools that allow users to conduct detailed analyses and obtain insights that can be used to guide future research and advancements. These tools should allow for detailed queries and reports to be made across different factors, such as (to only name a few), demographics, social history, process time, costs, quality outcomes, and patient satisfaction.

Remaining with the current EMR systems will reinforce barriers on research and informatics. These barriers separate clinicians and researchers into different silos. While clinicians without ready access to evidence-based information of their own outcomes are conducting procedures and caring for patients, researchers are conducting studies that remain theoretical or conceptual because of disparate data that is located in many different places and usually does not link different categories to one another (i.e. process time, quality outcomes, and patient satisfaction). These separate silos create added barriers that are not found in integrated universal systems. Fully integrated systems, like the United Kingdom's National Health Services or the United States' Veterans Health Administration, allow for queries and data pulls of all information collected (Browne et al., 2008).

Costs

Cost data was not available on the individual patient level for the inpatient setting. Therefore, this information was not included in the results and conclusion section of the document, as the data could not be analyzed using statistical methods. Some of the information found in Appendix I illustrates how costs for UKAs are less for the outpatient setting as compared with the inpatient setting with the limited data that was available. Although the average Gross Charges do not specifically represent the Costs of UKAs, they still present an important market value difference between the outpatient and inpatient settings. The average Direct Costs value is more closely related to the real life costs of UKAs, in both settings, though the outpatient setting has less Direct Costs. Even though the average Revenue to the facility is lower for outpatient UKAs, this balanced by less average Direct Costs for UKAs performed in the outpatient setting. The cost effectiveness can motivate all parties involved, which means that the more payers there are, the more providers there will be, and the more patients who will have outpatient UKAs performed.

Transitioning procedures to the outpatient setting has been found to generate cost savings in several studies. Transitioning to outpatient treatment of decompensated congestive heart failure, through the use of outpatient Nesiritide administration, dropped costs over $800,000, for a full course of treatment per patient (Josephson & Barnett, 2004). Another study found, transitioning to outpatient care for pharmaceuticals, such as chemotherapy for colorectal cancer, was shown to impact both medical costs as well as caregiver-opportunity costs by approximately 16% (Eun-Hye, Sun-Young, Joong Bae, & Hye-Young, 2011). Another study found that performing a laparoscopic cholecystectomy in the outpatient setting reduced the costs of the procedure by approximately 52% (Paquette, Smink, & Finlayson, 2008).

A 10-year review of thyroid surgeries in two national databases found an outpatient setting average per capita cost of $7,222 compared with $22,537 in the inpatient setting (Sun, DeMonner & Davis, 2013). Even when analyzing transitions to outpatient surgeries by other measures, such as the per-capita costs, the outpatient costs were three-times less. This study analyzed cost, but did not analyze quality outcomes or patient satisfaction for thyroidectomies.

In Canada there was an average of 48% savings when hospitals transitioned inpatient surgeries to the outpatient setting (Welsh, 1995). Specifically, transitioning to outpatient-centered care has decreased costs by 21% for outpatient laparoscopies, 48% for general surgeries, and, at times, up to 70% for non-surgical outpatient services in Canada. Further, cost savings of up to 70% could be reached by performing surgeries in the outpatient setting as compared with the inpatient setting. These cost savings were recorded for the following surgical procedures: curettage, laparoscopy, hernia repair, breast biopsy, cataract removal, and hemorrhoid removal. This article did not tie cost savings directly to impacts on quality outcomes and patient satisfaction.

Studies conducted in Germany have found significant cost savings after transitioning surgical procedures to the outpatient setting (Haack, 2009). The cost savings in general surgeries (i.e. appendix and gallbladder removals) performed in the outpatient setting were 15%. Another study found that total knee arthroplasty, ACL reconstruction, and shoulder arthroscopy had cost savings of 40%, 63%, and 85% respectively when performed in the outpatient setting (Strobel, 2010).

Future Research

The literature regarding outpatient UKAs is sparse, so there is a great deal of future research opportunities. These opportunities can be found in a more detailed analysis of the variable categories utilized in this study, such as process time, quality outcomes, and patient satisfaction. There are also opportunities in the design of future studies to compare outpatient UKAs with inpatient UKAs. Lastly, there are also opportunities for the study methods utilized in this research to be expanded and modified for future research.

Analysis

Future research into process time can analyze specific numbers of days/hours spent after leaving the operation room, until discharge, and then back home. Detailing the process time by the number of days hours spent in the outpatient and inpatient setting for UKAs and other procedures could show fine-grain differences in future research. These potential differences in time can also have an impact on costs, quality outcomes, and patient satisfaction.

Future research can focus on the detailed line-item analysis of reimbursements, the patient portion of payment, the direct and indirect costs of UKAs, and the costs of post-operative care, whether at home or in the hospital. Another future analytical variable could be the comparison of patients' costs to payers' costs to physician costs and reimbursements. This detailed analysis of reimbursements would include the patients' portion (copay and coinsurances). Future analysis could detail the specific direct and indirect costs necessary for conducting a UKA. These direct costs would include calculations related to surgical consumables and resources needed to hold a patient at each phase of the surgery. Indirect costs that could be analyzed include overhead, facility fees, rent, and cost sharing. Future research can analyze the cost of post-operative care for UKAs in both the outpatient and inpatient settings. These post-operative costs include the differences between the recovery at home versus the recovery in an inpatient ward, with regards to wound care, pain control, nursing, and physical therapy.

A future research opportunity for UKAs and other surgeries is a detailed analysis and differentiation of patient satisfaction, function/mobility, and pain to break down what happens to each patient, both pre-operatively and post-operatively. Indeed, the inpatient setting may have better documentation in regards to post-operative pain and other quality outcomes measure since the patient is under constant care of nurses. In home health, the provider is reliant upon family members to interpret what negative outcomes look like. Future research can develop a standalone measurement based on satisfaction and outcomes that more accurately measure the experience of a patient before and after a UKA.

Study Design

Future research can also utilize a prospective analysis for UKAs. After a prospective analysis is done, a study of other procedures – to see if they can be performed in the outpatient setting – is another possible future direction. There is great potential for future studies to use a prospective analysis in order to more tightly control the variables of study, the measurement methods, and the sampling methods. The conceptual framework, theoretical framework, and methodology presented in this study could be used for other commonly-performed procedures to see if they could be performed in the outpatient setting. Analyzing multiple specialties with multiple variables would allow for systematic reviews of procedures performed in both the outpatient and inpatient settings to establish what can be performed safely, effectively, and efficiently in the outpatient setting.

Future research can categorize and measure UKAs based on the compartments being replaced: medial compartment, which is inside of the knee; the lateral compartment, which is between the thigh and the shinbone, outside of the knee; and the patello-femoral compartment, which is the kneecap. Future research can identify which compartments are impacted and which surgery will be performed to compare the process time, costs, quality outcomes, and patient satisfaction in both the outpatient and inpatient setting. Separating the types of UKAs by both which leg will be operated on and which compartments will be replaced can further increase the detail of this analysis.

Another future research opportunity is possible through the comparison of UKAs in the hospital outpatient, hospital inpatient, and outpatient ambulatory freestanding facilities to measure the differences of the outpatient and inpatient setting. An analysis of UKAs in the outpatient and inpatient setting can be conducted that includes the characteristics of facilities on both the individual and the regional aggregate level. This expanded multilevel analysis can increase the validity and reliability of the analysis because the analysis can control for interactions and impacts of the facility type as well as the region that facilities are located.

Study Methods

As a secondary data resource in a de-identified manner for future research, UKAs can be analyzed based on the data available from the Centers for Medicare & Medicaid Services (CMS). Many quality outcomes and patient satisfaction indicators must be reported with any and all claims made for reimbursement through CMS. Furthermore, CMS data can remove selection bias in measuring samples of convenience.

Structural Equation Modeling (SEM) can be utilized in future research of UKAs in the outpatient and inpatient settings. SEM evaluates whether the proposed causal relationship is consistent with the actual patterns found among variables in the empirical data. With SEM analysis, there can be unobserved or latent variables, variables that are related to one another (multicollinearity), and multiple simultaneous analyses can be performed without reducing the R^2 (amount of variance explained). Examples of these latent variables could be level of outpatient care or level of home health.

A longitudinal study to look at long-term outcomes of patients could also be a future research opportunity. A longitudinal design of the study can utilize medical case analysis to link or associate claims that are part of the same treatment episode on a patient-unit level. Different time points can be measured both to create a baseline and to see, in real time, if the setting of a UKA impacts process time, quality outcomes, and patient satisfaction over time.

Propensity Score Matching (PSM) can be utilized in future research if there are confounding factors that may influence the dependent variables in future studies. PSM is utilized to make causal inferences by comparing group differences, which could result due to group selection bias and confounders. Based on the setting in which the UKA is performed, using PSM can lessen the impact of demographic and comorbidity characteristics on process time, costs, quality outcomes, and patient satisfaction.

As detailed above, opportunities for future research are endless. As our healthcare system changes, so will the procedures and variables that need to be developed and measured. Developing measures that can be combined to analyze variables such as Process Time, Costs, Quality Outcomes, and Patient Satisfaction, can effectively transition procedures from the inpatient setting to the outpatient setting. The endless rise of healthcare expenditures can be reversed through development of surgical and post-operative techniques that are efficient and emphasize patient safety and cost containment. For patients undergoing UKAs in the outpatient setting they spend less Time in ASU/Pre-Op, Surgery Preparation Time, Time in Operating Room, Time in the Post-Anesthesia Care Unit, and Total Enterprise Throughput Time; have a lower chance of Non-Surgery Related Complications, Follow-Up Pain, Follow-Up Functional Range of Motion Limitation; and are more Pleased with the Results of UKA and have better Visual Analog Scale for Patient Satisfaction. Driven by improved variables, application of theoretical models will continue to be important to systematically study improvements in our health care system, and therefore impacting national policy change. Purposeful change is the only constant for the future of our health care system. Modeling of health care structure as applied to a high volume of costly procedures is one such proposed start to purposeful change.

APPENDIX A
LITERATURE REVIEW TABLES

Literature Review of Outpatient Care

Reference	Topic of Study	Findings	Comments
Berger, Kusuma, Sanders, Thill, & Sporer, 2009	To study the feasibility of transitioning knee arthroplasty to the outpatient setting.	111 same-day surgical patients were analyzed from January 2006 to October 2006. Eighty-six patients underwent total knee arthroplasty, six had to stay overnight due to pain and fear of discharge. Of the twenty-five patients that underwent UKA, one stayed overnight due to nausea. No one was readmitted. For the total knee arthroplasties, four patients had to be readmitted due to anemia, gastrointestinal bleeding, or deep vein thrombosis. UKA was deemed safe and feasible to transition to outpatient-centered care when controlling for patient demographics and comorbidities.	Acceptably transitioning to outpatient-centered UKAs. Although this study did not look at costs or patient satisfaction, it is still a source that highlights multiple clinical indicators used to analyze whether or not a surgical procedure should be transitioned to the outpatient setting.
Carayon, Hundt, Alvarado, Springman, & Ayoub, 2006	To understand the perceptions of healthcare providers with regards to patient safety in outpatient procedures.	Utilizing a survey instrument, seventy-nine respondents (a 35% response rate) in five outpatient centers were analyzed in this study. A two-part survey with open-ended (qualitative data) and closed-ended (quantitative data) questions to physicians and to other outpatient surgery staff was provided. Physicians that scored centers highly had improved perception but were less able to identify patient safety issues. Obtaining input from all healthcare providers regarding the quality and safety of care rather than relying only on traditional measures about patient outcomes were highlighted	Specifically, this study analyzes safety in outpatient centers. It mentions aspects of safety rather than just surgical outcomes (e.g. cancellations of surgeries, coordination, communication, timeliness, organization, and serious mistakes). This study does not address costs as part of the analysis.

Reference	Topic of Study	Findings	Comments
		in this study for a more accurate picture.	
Chukmaitov, Menachemi, Brown, Saunders, & Brooks, 2008	To compare quality outcomes between Ambulatory Surgery Centers and Hospital Based Outpatient Departments.	A cross-sectional, risk-adjusted study was conducted. It found that neither ambulatory surgery centers nor hospital-based outpatient departments did better overall. However, some variations did appear when the data was broken down by procedure. Often, these variations favored hospital-based outpatient departments for more invasive procedures and ambulatory surgical centers for less invasive or diagnostic procedures. The authors also found that risk-adjustment was an important tool in analyzing ambulatory versus hospital based data.	This study confirms that, although hospital-based outpatient surgical departments may excel in more complex procedures, in some cases Ambulatory Surgery Centers provide higher quality care. Thus, more research is needed to identify which procedures should be preferentially performed in the outpatient setting.
Larsen, Hansen, Søballe, & Kehlet, 2012	To measure the satisfaction and function of patients pre- and post-UKA.	211 patients were surveyed through three separate standardized surveys, twice pre-surgery and twice post-surgery twice. Researchers found that, in four-month and twelve-month follow-ups, patients had improved function and satisfaction.	This study looks at patient perception and functionality in knee arthroplasties, specifically UKAs. It does not empirically analyze multiple quality outcomes, costs, and patient satisfaction of UKA as a whole or specifically in the outpatient setting as compared with the inpatient setting.
Levy & Mashoof, 2000	To evaluate cost savings, patient satisfaction, and post-operative complications when twenty-five patients were discharged home after open shoulder Bankart shoulder joint repair surgery.	Outpatient Bankart shoulder joint repair surgery in the outpatient setting resulted in immediate discharge, reducing costs to the institution by 56%. Surveyed patients reported 88% satisfaction, although three patients would have liked an overnight admission for recovery. There were no post-operative complications.	Outpatient Bankart shoulder joint repair surgery decreased the cost to the institution by over half without resulting in complications. Therefore, the authors support the use of outpatient surgery for this particular procedure, and they emphasize that adequate post-operative pain control and home support were crucial to the high rate of patient satisfaction.

Literature Review of Comparing Outpatient Process Time with Inpatient Process Time

Reference	Topic of Study	Findings	Comments
Munnich & Parente, 2014	To compare hospital outpatient departments to ambulatory surgical centers to explore the impact of process time on costs utilizing CDC and National Survey of Ambulatory Surgery Data.	The study found that ambulatory surgery centers spent 31.8 less minutes performing procedures when compared with the outpatient hospital department's 125 minutes. Cost savings for time are $29–$80 per minute. These cost savings per minute save approximately $363–$1,000 per procedure.	This significant difference between hospital outpatient and ambulatory outpatient time and costs points towards a larger difference between the outpatient and the inpatient settings. The study does not compare quality outcomes or patient satisfaction.

Literature Review of Comparing Outpatient Costs with Inpatient Costs

Reference	Topic of Study	Findings	Comments
Haack, 2010	A German study that measured the overall impact of transitioning inpatient general surgical procedures (i.e. appendix and gallbladder) to the outpatient setting.	Outpatient surgery has comparable or improved quality outcomes than it does in the inpatient setting. Procedures and treatments conducted in an outpatient setting lower costs with lower infection rates, earlier return to work, lower medication use, and high levels of patient satisfaction.	Transitioning procedures to the outpatient setting generates high quality outcomes. This can eliminate the need to admit patients for procedures in the inpatient setting other than on medical grounds.
Strobel, 2010	To highlight the development of the decision-making process on whether to conduct knee procedures in the inpatient or outpatient setting in Germany.	The outpatient setting has high quality outcomes, cost effectiveness, and cost efficiency. The study found cost savings of 40% for outpatient knee arthroscopy, 63% for outpatient ACL reconstruction, and 84% for outpatient shoulder arthroscopy. After risk-adjustment on comorbidities, objective decisions can be made on whether a patient should have their surgery in the inpatient or outpatient setting.	The study proves that, even taking comorbidities into account, the outpatient setting still has improved quality outcomes, which are also cheaper to the healthcare system.
Sun, DeMonner & Davis, 2013	To compare costs of inpatient and outpatient thyroid surgery.	In this comparative cross-sectional study, the costs of thyroid surgery that took place between 1996 and 2006 in the inpatient and outpatient settings were analyzed. Nationwide databases were utilized, namely the National Survey of Ambulatory Surgery for the outpatient setting and the Nationwide Inpatient Sample for the inpatient setting. Thyroidectomies performed in the inpatient setting had a per-capita cost of approximately 3 times that of thyroidectomies performed in the outpatient setting ($22,537	The study provides evidence of cost savings when comparing outpatient to inpatient surgical procedures. It does not detail what leads to the differences in costs. Also, it does not look at quality outcomes and patient satisfaction.

Reference	Topic of Study	Findings	Comments
		versus $7,222, respectively).	
Welsh, 1995	An evaluation of literature describing the transition from inpatient to outpatient care and comparing the two settings.	In Canada, it was shown there were 48% average savings when transitioning all services from the inpatient to the outpatient setting. Further, cost savings of up to 70% could be reached by performing surgeries in the outpatient setting as compared with the inpatient setting. In regards to cost comparisons of outpatient laparoscopies and inpatient laparoscopies, the outpatient setting had 21% savings. The surgeries analyzed were Curettage, Laparoscopy, Hernia, Breast Biopsy, Cataracts, and Hemorrhoids.	The article described the overall transition of some services from the inpatient to the outpatient setting. Throughout the history of the transition, there was a non-systematic manner to moving services to outpatient care. Quality outcomes and patient satisfaction were not primary goals. The basis of this article was mainly cost-based. As an afterthought to the profit-motivated transition, the article touched upon the outpatient setting's possibilities of increased safety. The study does not combine the analysis of quality outcomes, cost, and patient satisfaction together.

Literature Review of Comparing Outpatient Quality Outcomes with Inpatient Outcomes

Reference	Topic of Study	Findings	Comments
Browne, Jamieson, Lewsey, van der Meulen, Copley, & Black, 2008	To compare the inpatient National Health Services (NHS) setting to the outpatient Independent Sector Treatment Centres (ISTC) setting with regards to quality outcomes.	This prospective cohort study analyzed 769 patients in six ISTCs versus 1895 patients in twenty NHSs who were treated for several surgical procedures. Patients undergoing cataract surgery or hip replacement in ISTCs achieved a slightly greater improvement in functional status and quality of life than those treated in NHS facilities. There was no difference for patients undergoing hernia repair. Patients treated in ISTCs were less likely to report post-operative problems than those treated in NHS facilities, for cataract surgery.	Specifically, set up in 2003 in Britain, ISTCs were new to the NHS system. They were created to focus on outpatient surgery, such as low risk ophthalmic, orthopedic, and outpatient day surgery.
Kolisek, McGrath, Jessup, Monesmith, & Mont, 2009	To prospectively analyze outpatient versus inpatient outcomes for post-operative care in patients who have undergone Total Knee Arthroplasty.	Outpatient protocols for total knee arthroplasty are safe in selected patient populations and are comparable to inpatient protocols and quality outcomes. These results have been demonstrated across multiple surgeons and across multiple indicators including functional status, ranges of motion, patient satisfaction, and radiographic outcomes.	Transitioning some of the burden towards outpatient surgical care should be pursued when possible. Further research of the cost-benefit of outpatient-based total knee arthroplasty protocols and studies to help define which patient populations benefit most from outpatient based total knee arthroplasty protocols are needed.
Stieber, Brown, Donald, & Cohen, 2005	To evaluate and comparing the quality outcomes of performing anterior cervical dissection and fusion (ACDF) in the inpatient and	Previously, ACDF had never been performed on an outpatient basis. This retrospective review selected patients based on inclusion criteria for the outpatient group (at an	Certain patient populations can be selected to undergo outpatient procedures. This should be decided on a patient-by-patient basis based on risk factors. Complications are

Reference	Topic of Study	Findings	Comments
	outpatient settings.	ambulatory surgery center), with no statistical significance between the outpatient group and inpatient control groups. Adverse effects in the outpatient group included dysphagia, which was transient and self-limiting, and respiratory distress secondary to increased operative time and operative technique. No patients in the outpatient group required hospital admission, and the complication rate was lower in the outpatient setting.	decreased in the outpatient setting and can result in decreased or zero hospital admissions.

Literature Review of Comparing Outpatient Patient Satisfaction With Inpatient Patient Satisfaction

Reference	Topic of Study	Findings	Comments
Gamotis, Dearmon, Doolittle, & Price, 1988	To measure patient satisfaction of surgical patients in the outpatient versus inpatient setting.	The study analyzed 183 elective surgery patients – ninety-nine inpatients (over six months) and eighty-four outpatients (over four months) – using a likert-type unmated instrument. It found that outpatients were significantly more satisfied with their nursing care than their counterparts in the inpatient setting.	PSI is an important tool for comparison. Three dimensions of patient satisfaction were analyzed: the technical-professional relationship, educational relationship, and trusting relationship. The outpatient setting was seen to have a much higher satisfaction with nursing care than the inpatient setting.
Summers, Dawe, & Stewart, 2000	To compare the effects of outpatient and inpatient high-dose chemotherapy and autologous stem cell transplantation (ASCT) in the outpatient and inpatient setting.	The study utilized observational methods to collect a sample over seven months of twenty inpatients and twenty-one outpatients. It concluded that outpatient ASCT is a high quality, efficient, effective, and acceptable form of care for motivated patients and caregivers who have the physical and psychological capability and desire to receive cancer treatment in this manner.	Study results suggest that a targeted and integrated range of measurements is necessary to understand the difference between the two groups. However this self-selected group was created based on the patients' physical status, psychological well-being, quality of life, personal finances, and caregivers' burden.

Literature Review of Comparing Outpatient Combined Approach with Inpatient Combined Approach

Reference	Topic of Study	Findings	Comments
Castells, Alonso, Miguel, Cristina, Francesc, & Josep, 2001	A comparison of clinical and perceived health outcomes and costs between outpatient and inpatient cataract eye surgery in Spain.	464 outpatients and 471 inpatients in Spain were compared in terms of post-operative surgical complications, visual function, health status, and costs. Outpatients showed one complication within twenty-four hours post-operatively more frequently than in the inpatient setting. However, after four months, there was no difference in perceived or clinical outcomes (thus, there was no clinical difference overall) between outpatient and inpatient cataract surgery. Outpatient cataract procedure costs were 200 Euros less than inpatient cataract procedure costs. Results show cost effectiveness.	This study showed that, across the dimensions of health quality outcomes, there was no relevant overall perceived or clinical difference between outpatients and inpatients that underwent cataract surgery. Costs were less if it was an outpatient procedure, however, and it was therefore deemed more effective for cataract surgery. As an excellent example of a surgery that has been transitioned to the outpatient setting in most parts of the world, cataract surgery has comparable or improved characteristics in the outpatient rather than the inpatient setting. The study did not include patient satisfaction information.
Lansingh, Carter, and Martens, 2007	To compare the cost-effectiveness of cataract surgery patients undergoing cataract surgery in the outpatient and inpatient setting, this study documented perception, satisfaction, outcomes, costs, and characteristics of patients in Australia.	Cataract surgery all over the world has made the massive migration to outpatient-centered surgery. Cost information was provided by private insurance companies and then analyzed. Outpatients took less time to recover. Satisfaction between the two settings was comparable. Cost and charges for outpatient cataracts were significantly less.	The article looks satisfaction, perceived quality adjusted life year, and costs of outpatient cataract surgery as compared with inpatient cataract surgery. It shows that the transition was successful since the indicators measured were either comparable or improved and included less cost. The article lends support to transitioning to outpatient cataract surgery.
Jamali, Scott, Rubash, & Freiberg, 2009	A literature review article that looked at the history and outcomes of UKA. It also looks to the future of UKA in the	UKA has high potential in increasing quality outcomes if performed correctly. Furthermore, outpatient UKA decreases costs from $16,000	The literature points to the viability of outpatient UKA if pain management and other post-operative techniques are improved. It

Reference	Topic of Study	Findings	Comments
	outpatient setting.	to $7,000, which amounts to approximately $9,000, or 43%, savings in costs as compared with inpatient UKA.	does not directly compare the UKA in the outpatient and inpatient setting, except cost-wise. It does not directly analyze patient satisfaction, but it does mentioned that the improvements in quality outcomes and costs should improve patient satisfaction.
Krywulak, Mohtadi, Russell, & Sasyniuk, 2005	Measurement of patient satisfaction one week after ACL reconstruction surgery when patients remained hospitalized overnight post-operatively compared with when they were discharged to their homes post-operatively.	Although patients received the same pre-operative education and were required to meet the same discharge criteria, patients who were discharged to their homes within one hour of ACL reconstruction surgery reported a statistically significantly improved satisfaction score and had no difference in outcomes than patients who were hospitalized overnight. Quality outcomes were analyzed and no significant differences across different measures were found.	If there is no medical reason to keep a patient hospitalized, then it is in the best interest of the patient (satisfaction and cost) and the institution (cost) to discharge the patient. This lends credence to the transition to outpatient-centered care where patients go home the same day as the procedure. This study did not analyze costs.
Paquette, Smink, & Finlayson, 2008	A retrospective cohort review comparing laparoscopic cholecystectomy in the outpatient and inpatient setting.	The study found that for slightly younger and healthier patients, laparoscopic cholecystectomies could be performed successfully and with the same quality outcomes in the outpatient setting with comparable or improved results. The cost of outpatient laparoscopic cholecystectomy was $6,100 versus the $11,785 in the inpatient setting. This decreases costs by approximately $5,700 or 52%.	In addition to significant cost savings, the overall quality outcomes for laparoscopic cholecystectomy were comparable or improved in the outpatient setting. If institutions needed patients to be admitted, then the number of days they spent in the hospital was less for patients in the outpatient setting. The study did not analyze patient satisfaction.

APPENDIX B
DATA DICTIONARY

Variable	Coded Values	Definition
Inpatient Setting	1 = Outpatient (reference category) 2 = Inpatient	Outpatient or Inpatient as denoted in location in Electronic Medical Record
Year of Service	1 = 2009 2 = 2010 3 = 2011 4 = 2012 5 = 2013 6 = 2014 (reference category)	Year of Service of UKA as denoted in date of surgery in Electronic Medical Record
Knee	1 = Left (reference category) 2 = Right 3 = Both Knees	Knee UKA performed on as denoted in Electronic Medical Record
Implant	1 = Biomet Oxford (reference category) 2 = Zimmer Zuk	Implant used as denoted in the scanned bar code in Electronic Medical Record Before September 10, 2010 Biomet Oxford After September 10, 2010 Zimmer ZUK
Age	Numerical	Age of patient calculated by date of birth to surgery date as in demographics section of Electronic Medical Record
Gender	1 = Male (reference category) 2 = Female	Gender as denoted in demographics section of Electronic Medical Record
Race	0 = Not Specified "Race Not Specified" 1 = White (reference category) 2 = African American	Race of patient as denoted in demographics section of Electronic Medical Record
Marital Status	0 = Not Specified 1 = Married (reference category) 2 = Widow 3 = Divorced 4 = Single 5 = Separated	Marital Status of patient as denoted in social history section of Electronic Medical Record
Employment Status	0 = No "Employment No" (reference category) 1 = Full Time 2 = Part Time	Employment status of patient as denoted in social history of Electronic Medical Record
Alcohol Consumption	0 = No (reference category) 1 = Yes	Alcohol Consumption of patient as denoted in social history of Electronic Medical Record
Tobacco Use	0 = No (reference Category) 1 = Yes	Smoker, non-smoker, former smoker as denoted in social history of Electronic Medical Record

Variable	Coded Values	Definition
	2 = Former	
Physical Activity	0 = No (reference category) 1 = Yes	Regular Physical Activity (exercise) or not as denoted in social history of Electronic Medical Record
Charlson Index	Numerical	Sum of total of the following information found in the Electronic Medical Record – 1 point for each decade above 40 years of age. 1 point for Myocardial infarction; Congestive heart failure; Peripheral vascular disease; Cerebrovascular disease; Dementia; Chronic pulmonary disease; Rheumatologic disease; Peptic ulcer disease; Mild liver disease; Diabetes without chronic complications. 2 points for: Diabetes with chronic complications; Hemiplegia or paraplegia, Renal disease; Any malignancy, including leukemia and lymphoma; Moderate or severe liver disease. 6 points for Metastatic solid tumor; AIDS/HIV
Cancer	0 = No (reference category) 1 = Yes	Cancer – Yes or No as denoted in medical history section of Electronic Medical Record
COPD	0 = No (reference category) 1 = Yes	COPD – Yes or No as denoted in medical history section of Electronic Medical Record
Degenerative Disc Disease	0 = No (reference category) 1 = Yes	Degenerative Disc Disease – Yes or No as denoted in medical history section of Electronic Medical Record
Diabetes	0 = No (reference category) 1 = Yes	Diabetes – Yes or No as denoted in medical history section of Electronic Medical Record
Heart Attack	0 = No (reference category) 1 = Yes	Heart Attack – Yes or No as denoted in medical history section of Electronic Medical Record
Hepatitis	0 = No (reference category) 1 = Yes	Hepatitis – Yes or No as denoted in medical history section of Electronic Medical Record
HIV	0 = No (reference category) 1 = Yes	HIV – Yes or No as denoted in medical history section of Electronic Medical Record
Stroke	0 = No (reference category) 1 = Yes	Stroke – Yes or No as denoted in medical history section of Electronic Medical Record
Time in Ambulatory Surgery Unit (ASU)/Pre-OP	Minutes	ASU in to ASU out. Calculated time based on scanned perioperative, intraoperative, and post-operative reports
Surgery Time	Minutes	Surgery Start to Surgery Stop. Calculated time based on time reported from scanned perioperative,

Variable	Coded Values	Definition
		intraoperative, and post-operative reports
Surgery Preparation Time	Minutes	OR in to Surgery Start. Calculated time based on time reported from scanned perioperative, intraoperative, and post-operative reports
Surgery Breakdown	Minutes	Surgery Stop to Surgery Out. Calculated time based on time reported from scanned perioperative, intraoperative, and post-operative reports
Time in Operating Room (OR)	Minutes	OR in to OR out. Calculated time based on time reported from scanned perioperative, intraoperative, and post-operative reports
Time in Post-Anesthesia Care Unit (PACU)	Minutes	PACU In to PACU Out. Calculated time based on time reported from scanned perioperative, intraoperative, and post-operative reports
Total Enterprise Throughput Time	Minutes	ASU in to Discharge. Calculated time based on time reported from scanned perioperative, intraoperative, and post-operative reports
Gross Charges	Dollars	Reported as average inpatient Gross Surgery Charges for fiscal years 2012- 2014 and outpatient level Gross Surgery Charges of performing a UKA as denoted in Excel report files provided to Dr. Kerina from Facilities
Direct Costs	Dollars	Reported as average inpatient Direct Costs for fiscal years 2012-2014 and outpatient patient level Direct Costs of performing a UKA i.e. surgical consumables and supply costs as denoted in Excel report files provided to Dr. Kerina from Facilities.
Revenue	Dollars	Reported as average inpatient facility reimbursement amount for fiscal years 2012-2014 and outpatient patient level reimbursements of performing a UKA as denoted in Excel files to Dr. Kerina from Facilities
Post-Operative Infections	0 = No (reference category) 1 = Yes	Positive test result or prophylactic treatment due to the following: swelling, discharge, redness, hot to touch as denoted in clinician notes and scanned documents sections of Electronic Medical Record; by the 3 month follow-up visit
Post-Operative Complications	0 = No (reference category) 1 = Yes	Revision of UKA or UKA to TKA, pneumonia, bloody drainage, effusion, SVT, swelling, hematoma, incision/drain, neuroma, aspiration – not including post-operative infection and DVT/PE as denoted in clinician notes and scanned documents sections of Electronic Medical Record; by the 3 month follow-up visit
Non-Surgery Related Complications	0 = No (reference category) 1 = Yes	Tape reaction, rash, UTI, allergic reaction, bakers cyst, fall, dark stools, muscle cramps as denoted in clinician notes and scanned documents sections of Electronic Medical Record; by the 3 month follow-

Variable	Coded Values	Definition
		up visit
Deep Vein Thrombosis/ Pulmonary Embolism	0 = No (reference category) 1 = Yes	Positive test result, ultra sound result, or prophylactic treatment as denoted in clinician notes and scanned documents sections of Electronic Medical Record; by the 3 month follow-up visit
Emergency Room Visits	0 = No (reference category) 1 = Yes	Visit to the Emergency Room as denoted in clinician notes and scanned documents sections of Electronic Medical Record; by the 3 month follow-up visit
Hospitalizations	0 = No (reference category) 1 = Yes	Patient admission after outpatient UKA or readmission after inpatient UKA as denoted in clinician notes and scanned documents sections of Electronic Medical Record; by the 3 month follow-up visit
Follow-Up Pain	0 = No (reference category) 1 = Yes	Pain that requires physician action outside the normal post-op orders: injections, stronger pain medicine, increasing dose of pain medication, additional physical therapy, x-ray, CT scan, knee manipulation, brace as denoted in clinician notes and scanned documents sections of Electronic Medical Record; by the 3 month follow-up visit
Follow-Up Functional Range of Motion	0 = No (reference category) 1 = Yes	Issues where 125 degrees of flexion is not achieved requiring physician action outside the normal post-op orders injections, additional physical therapy knee manipulation, brace as denoted in clinician notes and scanned documents sections of Electronic Medical Record; by the 3 month follow-up visit
Pleased with the Results of UKA	0 = No (reference category) 1 = Yes	Patient asked if they are pleased with the results of the UKA. Recorded as Pleased with Result as denoted in clinician notes sections of Electronic Medical Record; by the 3 month follow-up visit
Visual Analog Scale For Patient Satisfaction	0 - 10	Patient is asked to rate their satisfaction based on a scale from 1 to 10 when they are presented with a graphic shown in appendix B, with 0 representing the most satisfaction and no discomfort and 10 representing the worst satisfaction and the highest discomfort as denoted in clinician notes sections of Electronic Medical Record; by the 3 month follow-up visit
Patient Perception of Satisfaction	0 = No (reference category) 1 = Yes	Patient is asked their perception of satisfaction and they respond with one of the following: doing well, doing great, doing fantastic, or doing excellent as denoted in clinician notes sections of Electronic Medical Record; by the 3 month follow-up visit

APPENDIX C
AUTHORIZATION OF USE OF DATA

Tri County
ORTHOPAEDIC CENTER

J. Mandume Kerina, M.D.
Board Certified in Orthopaedic Surgery
Fellow, American Academy of
Orthopaedic Surgeons

Claudia L. Thomas, M.D.
Board Certified in Orthopaedic Surgery
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John T. Williams, Jr. M.D.
Board Certified in Orthopaedic Surgery
Fellow, American Academy of
Orthopaedic Surgeons

July 17, 2013

To Whom It May Concern:

My name is J. Mandume Kerina and I am Orthopedic Surgeon and owner of Tri County Orthopedic Center. I have discussed and understand the concept of Ibrahim Mamdouh Zeini's dissertation titled Improving Quality Outcomes and Patient Safety: Transitioning to Outpatient-Centered Care. Furthermore, I have approved the use of the patient records to compare quality outcomes of patients that have undergone knee replacement surgery in both the inpatient and outpatient settings for this dissertation. If you have any questions please feel free to contact me at (352) 636-0141 or tcmedicalfnd@aol.com Thank you very much.

Regards,

J. Mandume Kerina, MD

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APPENDIX D
IRB OUTCOME LETTER ORIGINAL

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Ibrahim Mamdouh Zeini**

Date: **December 10, 2014**

Dear Researcher:

On 12/10/2014, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review:	Exempt Determination
Project Title:	Does Transitioning to Outpatient Unicondylar Knee Arthroplasty Improve Process Time, Costs, Quality Outcomes, and Patient Satisfaction?
Investigator:	Ibrahim Mamdouh Zeini
IRB Number:	SBE-14-10802
Funding Agency:	
Grant Title:	
Research ID:	N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Joanne Muratori

Signature applied by Joanne Muratori on 12/10/2014 03:43:56 PM EST

IRB Coordinator

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APPENDIX E
IRB OUTCOME LETTER AMENDMENT ONE

University of Central Florida

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Ibrahim Mamdouh Zeini**

Date: **June 01, 2015**

Dear Researcher:

On 06/01/2015, the IRB approved the following modification to human participant research that is exempt from regulation:

Type of Review:	Exempt Determination
Modification Type:	Title modification
Project Title:	A COMPARISON OF OUTPATIENT UNICONDYLAR KNEE ARTHROPLASTY WITH INPATIENT UNICONDYLAR KNEE ARTHROPLASTY
Investigator:	Ibrahim Mamdouh Zeini
IRB Number:	SBE-14-10802
Funding Agency:	
Grant Title:	
Research ID:	N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Patria Davis on 06/01/2015 01:51:29 PM EDT

IRB Coordinator

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APPENDIX F
IRB OUTCOME LETTER AMENDMENT TWO

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Ibrahim Mamdouh Zeini**

Date: **November 02, 2015**

Dear Researcher:

On 11/02/2015, the IRB approved the following a minor modification to human participant research that is exempt from regulation:

Type of Review:	Exempt Determination
Modification Type:	The study title has been changed from "A COMPARISON OF OUTPATIENT UNICONDYLAR KNEE ARTHROPLASTY WITH INPATIENT UNICONDYLAR KNEE ARTHROPLASTY" TO "Unicondylar Knee Arthroplasty in the Inpatient vs Outpatient Setting: Impact on Process Time, Quality Outcomes and Patient Satisfaction."
Project Title:	Unicondylar Knee Arthroplasty in the Inpatient vs Outpatient Setting: Impact on Process Time, Quality Outcomes and Patient Satisfaction
Investigator:	Ibrahim Mamdouh Zeini
IRB Number:	SBE-14-10802
Funding Agency:	
Grant Title:	
Research ID:	N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Joanne Muratori

Signature applied by Joanne Muratori on 11/02/2015 01:59:23 PM EST

IRB Manager

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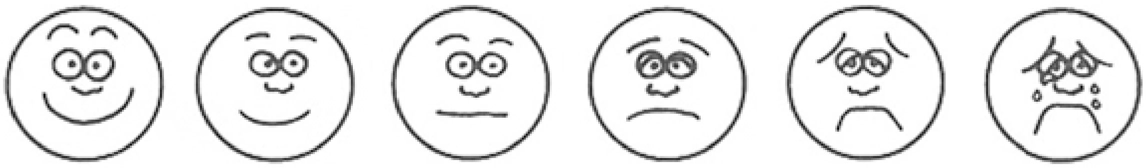
APPENDIX G
VISUAL ANALOG SCALE FOR PATIENT SATISFACTION



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APPENDIX H
REGRESSION ANALYSIS TABLES

Process Time

Time In ASU/Pre-Op

Time in ASU/Pre-Op Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.566[a]	.320	.304	48.079381862879290	1.758

a. Predictors: (Constant), Charlson Index, Tobacco Use Yes, Alcohol Consumption, Marital Status Not Specified, Both Knees, Widow, Separated, African American, Right Knee, 2011, Race Not Specified, Divorced, Part Time, Single, 2012, Physical Activity, Tobacco Use Former, 2010, Full Time, Female, 2009, Inpatient Setting, 2013, Age, Zimmer Zuk
b. Dependent Variable: Time in ASU/Pre-OP (ASU in to ASU out)

Time in ASU/Pre-Op ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1141862.857	25	45674.514	19.759	.000[b]
	Residual	2424896.681	1049	2311.627		
	Total	3566759.539	1074			

a. Dependent Variable: Time in ASU/Pre-OP (ASU in to ASU out)
b. Predictors: (Constant), Charlson Index, Tobacco Use Yes, Alcohol Consumption, Marital Status Not Specified, Both Knees, Widow, Separated, African American, Right Knee, 2011, Race Not Specified, Divorced, Part Time, Single, 2012, Physical Activity, Tobacco Use Former, 2010, Full Time, Female, 2009, Inpatient Setting, 2013, Age, Zimmer Zuk

Time in ASU/Pre-Op Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	21.157	27.478		.770	.441	-32.761	75.076
	Inpatient Setting	48.957	3.437	.411	14.246	.000	42.214	55.700
	2009	-21.533	12.709	-.100	-1.694	.091	-46.472	3.406
	2010	-19.787	8.487	-.090	-2.331	.020	-36.441	-3.134
	2011	-15.115	5.303	-.084	-2.850	.004	-25.521	-4.709
	2012	-6.257	4.601	-.040	-1.360	.174	-15.286	2.771
	2013	18.126	4.044	.138	4.482	.000	10.191	26.060
	2014 (Ref. Cat.)							
	Left Knee (Ref. Cat.)							
	Right Knee	.814	2.967	.007	.274	.784	-5.008	6.636
	Both Knees	8.721	28.050	.008	.311	.756	-46.319	63.762
	Zimmer Zuk	12.673	10.952	.070	1.157	.247	-8.817	34.162

	Age	.059	.227	.008	.258	.796	-.387	.504
	Female	1.625	3.151	.014	.516	.606	-4.557	7.807
	Race Not Specified	-6.678	7.330	-.024	-.911	.362	-21.061	7.705
	White (Ref. Cat.)							
	African American	-13.797	10.145	-.035	-1.360	.174	-33.703	6.110
	Marital Status Not Specified	-20.060	22.117	-.024	-.907	.365	-63.459	23.339
	Married (Ref. Cat.)							
	Widow	12.767	5.020	.070	2.543	.011	2.916	22.618
	Divorced	8.146	8.663	.024	.940	.347	-8.853	25.144
	Single	4.103	7.230	.015	.567	.571	-10.084	18.289
	Separated	19.419	24.528	.021	.792	.429	-28.711	67.549
	Employment No (Ref. Cat.)							
	Full Time	4.481	6.238	.021	.718	.473	-7.759	16.721
	Part Time	-6.471	5.821	-.029	-1.112	.267	-17.893	4.951
	Alcohol Consumption	5.104	3.184	.043	1.603	.109	-1.144	11.351
	Tobacco Use No (Ref. Cat.)							
	Tobacco Use Yes	2.667	6.629	.011	.402	.688	-10.341	15.675
	Tobacco Use Former	-7.892	3.620	-.060	-2.180	.029	-14.996	-.788
	Physical Activity	-.628	3.066	-.005	-.205	.838	-6.644	5.388
	Charlson Index	-.374	1.138	-.010	-.328	.743	-2.607	1.860

a. Dependent Variable: Time in ASU/Pre-OP (ASU in to ASU out)

Surgery Time

Surgery Time Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.543[a]	.295	.278	14.895427347954264	1.750

a. Predictors: (Constant), Charlson Index, Tobacco Use Yes, Alcohol Consumption, Marital Status Not Specified, Both Knees, Widow, Separated, African American, Right Knee, 2011, Race Not Specified, Divorced, Part Time, Single, 2012, Physical Activity, Tobacco Use Former, 2010, Full Time, Female, 2009, Inpatient Setting, 2013, Age, Zimmer Zuk
b. Dependent Variable: Surgery Time (Surgery Start to Surgery Stop)

Surgery Time ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	97362.054	25	3894.482	17.553	.000[b]
	Residual	232745.570	1049	221.874		
	Total	330107.624	1074			

a. Dependent Variable: Surgery Time (Surgery Start to Surgery Stop)
b. Predictors: (Constant), Charlson Index, Tobacco Use Yes, Alcohol Consumption, Marital Status Not Specified, Both Knees, Widow, Separated, African American, Right Knee, 2011, Race Not Specified, Divorced, Part Time, Single, 2012, Physical Activity, Tobacco Use Former, 2010, Full Time, Female, 2009, Inpatient Setting, 2013, Age, Zimmer Zuk

Surgery Time Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	77.361	8.513		9.087	.000	60.657	94.065
	Inpatient Setting	5.045	1.065	.139	4.739	.000	2.956	7.134
	2009	17.961	3.938	.274	4.562	.000	10.235	25.687
	2010	23.839	2.629	.357	9.066	.000	18.679	28.998
	2011	14.890	1.643	.271	9.062	.000	11.666	18.114
	2012	7.188	1.425	.152	5.042	.000	4.390	9.985
	2013	.292	1.253	.007	.233	.816	-2.166	2.751
	2014 (Ref. Cat.)							
	Left Knee (Ref. Cat.)							
	Right Knee	-.303	.919	-.009	-.330	.741	-2.107	1.500
	Both Knees	61.491	8.690	.185	7.076	.000	44.439	78.543
	Zimmer Zuk	-4.509	3.393	-.082	-1.329	.184	-11.166	2.149
	Age	-.183	.070	-.087	-2.607	.009	-.321	-.045
	Female	-2.504	.976	-.071	-2.566	.010	-4.420	-.589
	Race Not Specified	3.401	2.271	.041	1.497	.135	-1.055	7.857
	White (Ref. Cat.)							
	African American	6.754	3.143	.057	2.149	.032	.587	12.921
	Marital Status Not Specified	2.580	6.852	.010	.377	.707	-10.865	16.026
	Married (Ref. Cat.)	2.132	1.555	.038	1.371	.171	-.920	5.184
	Widow	2.579	2.684	.025	.961	.337	-2.687	7.846
	Divorced	-.256	2.240	-.003	-.114	.909	-4.651	4.139
	Single	-9.495	7.599	-.033	-1.249	.212	-24.406	5.416
	Separated	6.754	3.143	.057	2.149	.032	.587	12.921
	Employment No (Ref. Cat.)							
	Full Time	1.316	1.933	.020	.681	.496	-2.476	5.108
	Part Time	-2.581	1.803	-.038	-1.431	.153	-6.120	.957
	Alcohol Consumption	.765	.986	.021	.776	.438	-1.170	2.701

	Tobacco Use No (Ref. Cat.)						
	Tobacco Use Yes	3.703	2.054	.049	1.803	.072	-.328	7.733
	Tobacco Use Former	.220	1.122	.005	.196	.845	-1.981	2.421
	Physical Activity	.751	.950	.021	.790	.430	-1.113	2.614
	Charlson Index	.163	.353	.014	.463	.644	-.529	.855

a. Dependent Variable: Surgery Time (Surgery Start to Surgery Stop)

Surgery Preparation Time

Surgery Preparation Time Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.350[a]	.123	.102	10.931768556776234	1.892

a. Predictors: (Constant), Charlson Index, Tobacco Use Yes, Alcohol Consumption, Marital Status Not Specified, Both Knees, Widow, Separated, African American, Right Knee, 2011, Race Not Specified, Divorced, Part Time, Single, 2012, Physical Activity, Tobacco Use Former, 2010, Full Time, Female, 2009, Inpatient Setting, 2013, Age, Zimmer Zuk
b. Dependent Variable: Surgery Prep Time (OR in to Surgery Start)

Surgery Preparation Time ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17542.470	25	701.699	5.872	.000[b]
	Residual	125359.238	1049	119.504		
	Total	142901.708	1074			

a. Dependent Variable: Surgery Prep Time (OR in to Surgery Start)
b. Predictors: (Constant), Charlson Index, Tobacco Use Yes, Alcohol Consumption, Marital Status Not Specified, Both Knees, Widow, Separated, African American, Right Knee, 2011, Race Not Specified, Divorced, Part Time, Single, 2012, Physical Activity, Tobacco Use Former, 2010, Full Time, Female, 2009, Inpatient Setting, 2013, Age, Zimmer Zuk

Surgery Preparation Time Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	31.802	6.248		5.090	.000	19.543	44.062
	Inpatient Setting	6.472	.781	.271	8.284	.000	4.939	8.006
	2009	1.535	2.890	.036	.531	.595	-4.136	7.205
	2010	5.351	1.930	.122	2.773	.006	1.565	9.138
	2011	7.889	1.206	.219	6.543	.000	5.523	10.256
	2012	1.329	1.046	.043	1.271	.204	-.723	3.382
	2013	-1.204	.919	-.046	-1.309	.191	-3.008	.600
	2014 (Ref. Cat.)							
	Left Knee (Ref. Cat.)							

	Right Knee	.415	.675	.018	.616	.538	-.908	1.739
	Both Knees	6.493	6.378	.030	1.018	.309	-6.021	19.008
	Zimmer Zuk	-1.771	2.490	-.049	-.711	.477	-6.657	3.115
	Age	-.013	.052	-.009	-.256	.798	-.115	.088
	Female	.167	.716	.007	.233	.816	-1.239	1.572
	Race Not Specified	1.972	1.667	.036	1.183	.237	-1.298	5.242
	White (Ref. Cat.)							
	African American	-.021	2.307	.000	-.009	.993	-4.547	4.506
	Marital Status Not Specified	-.607	5.029	-.004	-.121	.904	-10.474	9.261
	Married (Ref. Cat.)							
	Widow	-.156	1.141	-.004	-.137	.891	-2.396	2.084
	Divorced	-.953	1.970	-.014	-.484	.628	-4.818	2.912
	Single	-1.175	1.644	-.022	-.715	.475	-4.400	2.051
	Separated	-8.766	5.577	-.046	-1.572	.116	-19.710	2.177
	Employment No (Ref. Cat.)							
	Full Time	3.134	1.418	.072	2.210	.027	.351	5.917
	Part Time	.030	1.323	.001	.023	.982	-2.567	2.627
	Alcohol Consumption	-.009	.724	.000	-.013	.990	-1.430	1.411
	Tobacco Use No (Ref. Cat.)							
	Tobacco Use Yes	-2.070	1.507	-.041	-1.373	.170	-5.027	.888
	Tobacco Use Former	.416	.823	.016	.505	.614	-1.199	2.031
	Physical Activity	-1.468	.697	-.063	-2.107	.035	-2.836	-.101
	Charlson Index	.183	.259	.023	.708	.479	-.324	.691

a. Dependent Variable: Surgery Preparation Time (OR in to Surgery Start)

Surgery Breakdown Time

Surgery Breakdown Time Model Summary

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**Durbin-Watson**
1	.361[a]	.130	.109	7.880398769248165	1.816

a. Predictors: (Constant), Charlson Index, Tobacco Use Yes, Alcohol Consumption, Marital Status Not Specified, Both Knees, Widow, Separated, African American, Right Knee, 2011, Race Not Specified, Divorced, Part Time, Single, 2012, Physical Activity, Tobacco Use Former, 2010, Full Time, Female, 2009, Inpatient Setting, 2013, Age, Zimmer Zuk
b. Dependent Variable: Surgery Breakdown Time (Surgery Stop to Surgery Out)

Surgery Breakdown Time ANOVA

Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	9751.371	25	390.055	6.281	.000[b]
	Residual	65143.618	1049	62.101		

	Total	74894.990	1074			

a. Dependent Variable: Surgery Breakdown Time (Surgery Stop to Surgery Out)
b. Predictors: (Constant), Charlson Index, Tobacco Use Yes, Alcohol Consumption, Marital Status Not Specified, Both Knees, Widow, Separated, African American, Right Knee, 2011, Race Not Specified, Divorced, Part Time, Single, 2012, Physical Activity, Tobacco Use Former, 2010, Full Time, Female, 2009, Inpatient Setting, 2013, Age, Zimmer Zuk

Surgery Breakdown Time Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	**Std. Error**	**Beta**	**t**	**Sig.**	**Lower Bound**	**Upper Bound**
1	(Constant)	25.901	4.504		5.751	.000	17.063	34.738
	Inpatient Setting	-5.843	.563	-.338	-10.373	.000	-6.948	-4.738
	2009	-2.437	2.083	-.078	-1.170	.242	-6.525	1.651
	2010	-1.699	1.391	-.053	-1.221	.222	-4.428	1.031
	2011	-1.217	.869	-.047	-1.400	.162	-2.923	.488
	2012	-1.182	.754	-.053	-1.568	.117	-2.662	.297
	2013	-.477	.663	-.025	-.719	.472	-1.777	.824
	2014 (Ref. Cat.)							
	Left Knee (Ref. Cat.)							
	Right Knee	-.235	.486	-.014	-.484	.628	-1.190	.719
	Both Knees	-2.011	4.598	-.013	-.437	.662	-11.032	7.010
	Zimmer Zuk	-.882	1.795	-.034	-.492	.623	-4.405	2.640
	Age	-.025	.037	-.025	-.669	.503	-.098	.048
	Female	-.017	.516	-.001	-.032	.974	-1.030	.997
	Race Not Specified	1.072	1.201	.027	.892	.373	-1.286	3.429
	White (Ref. Cat.)							
	African American	-1.214	1.663	-.021	-.730	.465	-4.477	2.049
	Marital Status Not Specified	-4.787	3.625	-.039	-1.321	.187	-11.900	2.326
	Married (Ref. Cat.)							
	Widow	-.847	.823	-.032	-1.030	.303	-2.462	.767
	Divorced	3.639	1.420	.075	2.563	.011	.853	6.425
	Single	-1.577	1.185	-.040	-1.331	.184	-3.902	.748
	Separated	-1.438	4.020	-.010	-.358	.721	-9.326	6.451
	Employment No (Ref. Cat.)							
	Full Time	.668	1.022	.021	.654	.513	-1.338	2.675
	Part Time	.142	.954	.004	.149	.882	-1.730	2.014

	Alcohol Consumption	.007	.522	.000	.014	.989	-1.017	1.031
	Tobacco Use No (Ref. Cat.)							
	Tobacco Use Yes	.015	1.087	.000	.013	.989	-2.117	2.147
	Tobacco Use Former	.517	.593	.027	.872	.383	-.647	1.682
	Physical Activity	-.455	.502	-.027	-.905	.366	-1.441	.531
	Charlson Index	-.209	.187	-.037	-1.120	.263	-.575	.157

a. Dependent Variable: Surgery Breakdown Time (Surgery Stop to Surgery Out)

Time in Operating Room

Time in Operating Room Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.538[a]	.290	.273	18.483916664044198	1.794

b. Predictors: (Constant), Charlson Index, Tobacco Use Yes, Alcohol Consumption, Marital Status Not Specified, Both Knees, Widow, Separated, African American, Right Knee, 2011, Race Not Specified, Divorced, Part Time, Single, 2012, Physical Activity, Tobacco Use Former, 2010, Full Time, Female, 2009, Inpatient Setting, 2013, Age, Zimmer Zuk

b. Dependent Variable: Time in OR (OR in to OR out)

Time in Operating Room ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	146225.029	25	5849.001	17.120	.000[b]
	Residual	358396.279	1049	341.655		
	Total	504621.308	1074			

a. Dependent Variable: Time in OR (OR in to OR out)

b. Predictors: (Constant), Charlson Index, Tobacco Use Yes, Alcohol Consumption, Marital Status Not Specified, Both Knees, Widow, Separated, African American, Right Knee, 2011, Race Not Specified, Divorced, Part Time, Single, 2012, Physical Activity, Tobacco Use Former, 2010, Full Time, Female, 2009, Inpatient Setting, 2013, Age, Zimmer Zuk

Time in Operating Room Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	135.064	10.564		12.786	.000	114.336	155.793
	Inpatient Setting	5.675	1.321	.127	4.295	.000	3.082	8.267
	2009	17.059	4.886	.210	3.491	.001	7.471	26.646

	2010	27.492	3.263	.333	8.426	.000	21.089	33.894
	2011	21.562	2.039	.318	10.576	.000	17.561	25.563
	2012	7.335	1.769	.126	4.146	.000	3.864	10.806
	2013	-1.388	1.555	-.028	-.893	.372	-4.439	1.663
	2014 (Ref. Cat.)							
	Left Knee (Ref. Cat.)							
	Right Knee	-.124	1.141	-.003	-.108	.914	-2.362	2.115
	Both Knees	65.974	10.784	.161	6.118	.000	44.813	87.134
	Zimmer Zuk	-7.162	4.210	-.106	-1.701	.089	-15.423	1.100
	Age	-.222	.087	-.085	-2.538	.011	-.393	-.050
	Female	-2.354	1.211	-.054	-1.944	.052	-4.731	.022
	Race Not Specified	6.444	2.818	.063	2.287	.022	.914	11.974
	White (Ref. Cat.)							
	African American	5.519	3.900	.038	1.415	.157	-2.134	13.172
	Marital Status Not Specified	-2.814	8.503	-.009	-.331	.741	-19.498	13.871
	Married (Ref. Cat.)							
	Widow	1.129	1.930	.016	.585	.559	-2.658	4.916
	Divorced	5.265	3.330	.042	1.581	.114	-1.270	11.800
	Single	-3.008	2.780	-.030	-1.082	.279	-8.462	2.446
	Separated	-19.699	9.430	-.055	-2.089	.037	-38.202	-1.195
	Employment No (Ref. Cat.)							
	Full Time	5.119	2.398	.062	2.134	.033	.413	9.824
	Part Time	-2.410	2.238	-.029	-1.077	.282	-6.801	1.982
	Alcohol Consumption	.763	1.224	.017	.623	.533	-1.639	3.165
	Tobacco Use No (Ref. Cat.)							
	Tobacco Use Yes	1.647	2.549	.017	.646	.518	-3.354	6.648
	Tobacco Use Former	1.153	1.392	.023	.829	.408	-1.578	3.884
	Physical Activity	-1.173	1.179	-.027	-.995	.320	-3.485	1.140
	Charlson Index	.137	.438	.009	.314	.753	-.721	.996

a. Dependent Variable: Time in OR (OR in to OR out)

Time in Post-Anesthesia Care Unit

Time in Post-Anesthesia Care Unit Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.563[a]	.317	.301	60.384670759046130	1.868

a. Predictors: (Constant), Charlson Index, Tobacco Use Yes, Alcohol Consumption, Marital Status Not Specified, Both Knees, Widow, Separated, African American, Right Knee, 2011, Race Not Specified, Divorced, Part Time, Single, 2012, Physical Activity, Tobacco Use Former, 2010, Full Time, Female, 2009, Inpatient Setting, 2013, Age, Zimmer Zuk
b. Dependent Variable: Time in PACU (PACU In to PACU Out)

Time in Post-Anesthesia Care Unit ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1774982.650	25	70999.306	19.472	.000[b]
	Residual	3824977.577	1049	3646.308		
	Total	5599960.227	1074			

a. Dependent Variable: Time in PACU (PACU In to PACU Out)
b. Predictors: (Constant), Charlson Index, Tobacco Use Yes, Alcohol Consumption, Marital Status Not Specified, Both Knees, Widow, Separated, African American, Right Knee, 2011, Race Not Specified, Divorced, Part Time, Single, 2012, Physical Activity, Tobacco Use Former, 2010, Full Time, Female, 2009, Inpatient Setting, 2013, Age, Zimmer Zuk

Time in Post-Anesthesia Care Unit Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-58.338	34.511		-1.690	.091	-126.056	9.380
	Inpatient Setting	78.019	4.316	.522	18.076	.000	69.550	86.488
	2009	28.428	15.962	.105	1.781	.075	-2.894	59.749
	2010	22.530	10.659	.082	2.114	.035	1.614	43.446
	2011	24.145	6.661	.107	3.625	.000	11.075	37.215
	2012	34.407	5.779	.177	5.954	.000	23.067	45.746
	2013	7.298	5.079	.044	1.437	.151	-2.668	17.264
	2014 (Ref. Cat.)							
	Left Knee (Ref. Cat.)							
	Right Knee	-5.395	3.726	-.037	-1.448	.148	-12.707	1.917
	Both Knees	2.819	35.229	.002	.080	.936	-66.308	71.947
	Zimmer Zuk	1.507	13.755	.007	.110	.913	-25.482	28.497
	Age	.361	.285	.041	1.267	.206	-.198	.921
	Female	4.217	3.957	.029	1.066	.287	-3.548	11.981
	Race Not Specified	4.967	9.206	.014	.539	.590	-13.098	23.031
	White (Ref. Cat.)							
	African American	12.134	12.741	.025	.952	.341	-12.868	37.136
	Marital Status Not Specified	-14.765	27.778	-.014	-.532	.595	-69.271	39.742
	Married (Ref. Cat.)							
	Widow	5.887	6.305	.026	.934	.351	-6.486	18.259

	Divorced	5.583	10.880	.013	.513	.608	-15.766	26.932
	Single	-3.596	9.080	-.011	-.396	.692	-21.414	14.221
	Separated	-16.296	30.806	-.014	-.529	.597	-76.744	44.152
	Employment No (Ref. Cat.)							
	Full Time	8.888	7.834	.033	1.135	.257	-6.485	24.261
	Part Time	-3.804	7.311	-.014	-.520	.603	-18.149	10.542
	Alcohol Consumption	-2.055	3.999	-.014	-.514	.607	-9.901	5.791
	Tobacco Use No (Ref. Cat.)							
	Tobacco Use Yes	-.631	8.326	-.002	-.076	.940	-16.968	15.706
	Tobacco Use Former	-1.060	4.547	-.006	-.233	.816	-9.983	7.862
	Physical Activity	-10.636	3.850	-.073	-2.762	.006	-18.192	-3.081
	Charlson Index	.607	1.429	.012	.424	.671	-2.198	3.411

a. Dependent Variable: Time in PACU (PACU In to PACU Out)

Total Enterprise Throughput Time

Total Enterprise Throughput Time Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.631[a]	.398	.384	81.738636049967600	1.798

b. Predictors: (Constant), Charlson Index, Tobacco Use Yes, Alcohol Consumption, Marital Status Not Specified, Both Knees, Widow, Separated, African American, Right Knee, 2011, Race Not Specified, Divorced, Part Time, Single, 2012, Physical Activity, Tobacco Use Former, 2010, Full Time, Female, 2009, Inpatient Setting, 2013, Age, Zimmer Zuk
b. Dependent Variable: Total Enterprise Throughput (ASU in to Discharge)

Total Enterprise Throughput Time ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4636229.705	25	185449.188	27.757	.000[b]
	Residual	7008583.650	1049	6681.205		
	Total	11644813.354	1074			

a. Dependent Variable: Total Enterprise Throughput Time (ASU in to Discharge)
b. Predictors: (Constant), Charlson Index, Tobacco Use Yes, Alcohol Consumption, Marital Status Not Specified, Both Knees, Widow, Separated, African American, Right Knee, 2011, Race Not Specified, Divorced, Part Time, Single, 2012, Physical Activity, Tobacco Use Former, 2010, Full Time, Female, 2009, Inpatient Setting, 2013, Age, Zimmer Zuk

Total Enterprise Throughput Time Coefficients

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B

		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	112.467	46.715		2.408	.016	20.802	204.132
	Inpatient Setting	128.730	5.842	.598	22.034	.000	117.266	140.194
	2009	19.189	21.607	.049	.888	.375	-23.209	61.586
	2010	25.005	14.429	.063	1.733	.083	-3.308	53.318
	2011	27.038	9.016	.083	2.999	.003	9.346	44.729
	2012	33.277	7.822	.119	4.254	.000	17.928	48.627
	2013	21.019	6.875	.089	3.057	.002	7.529	34.509
	2014 (Ref. Cat.)							
	Left Knee (Ref. Cat.)							
	Right Knee	-4.665	5.044	-.022	-.925	.355	-14.563	5.233
	Both Knees	77.907	47.687	.039	1.634	.103	-15.666	171.480
	Zimmer Zuk	4.431	18.619	.014	.238	.812	-32.103	40.965
	Age	.284	.386	.023	.735	.463	-.474	1.041
	Female	.620	5.356	.003	.116	.908	-9.890	11.130
	Race Not Specified	3.716	12.462	.008	.298	.766	-20.737	28.168
	White (Ref. Cat.)							
	African American	4.024	17.247	.006	.233	.816	-29.819	37.867
	Marital Status Not Specified	-39.220	37.601	-.026	-1.043	.297	-113.002	34.562
	Married (Ref. Cat.)							
	Widow	20.127	8.535	.061	2.358	.019	3.380	36.875
	Divorced	19.232	14.727	.032	1.306	.192	-9.667	48.130
	Single	7.995	12.291	.016	.650	.516	-16.124	32.114
	Separated	-15.429	41.700	-.009	-.370	.711	-97.253	66.396
	Employment No (Ref. Cat.)							
	Full Time	17.329	10.605	.044	1.634	.103	-3.480	38.138
	Part Time	-13.997	9.896	-.035	-1.414	.158	-33.415	5.421
	Alcohol Consumption	1.960	5.413	.009	.362	.717	-8.661	12.581
	Tobacco Use No (Ref. Cat.)							
	Tobacco Use Yes	2.623	11.270	.006	.233	.816	-19.492	24.738
	Tobacco Use Former	-6.923	6.155	-.029	-1.125	.261	-19.001	5.154
	Physical Activity	-13.956	5.212	-.066	-2.678	.008	-24.183	-3.729
	Charlson Index	.241	1.935	.003	.125	.901	-3.556	4.038

a. Dependent Variable: Total Enterprise Throughput Time (ASU in to Discharge)

Quality Outcomes

Post-Operative Infections

Post-Operative Infections Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	22.403	25	.612
	Block	22.403	25	.612
	Model	22.403	25	.612

Post-Operative Infections Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	244.349[a]	.021	.094

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Post-Operative Infections Classification

Observed			Predicted		
			Post-Operative Infections		Percentage Correct
			No	Yes	
Step 1	Post-Operative Infections	No	1046	0	100.0
		Yes	29	0	.0
	Overall Percentage				97.3

a. The cut value is .500

Post-Operative Infections Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Inpatient Setting (1)	-.094	.455	.043	1	.837	.910	.373	2.220
	2009	-17.924	6274.069	.000	1	.998	.000	.000	.
	2010	-17.091	6274.069	.000	1	.998	.000	.000	.
	2011	-.785	1.097	.513	1	.474	.456	.053	3.911
	2012	.603	.580	1.079	1	.299	1.827	.586	5.699
	2013	.903	.513	3.102	1	.078	2.468	.903	6.742
	2014 (Ref. Cat.)								
	Left Knee (Ref. Cat.)								

	Right Knee	-.571	.396	2.079	1	.149	.565	.260	1.228
	Both Knees	-17.846	22909.299	.000	1	.999	.000	.000	.
	Zimmer Zuk	-18.214	6274.069	.000	1	.998	.000	.000	.
	Age	.024	.030	.660	1	.417	1.025	.966	1.086
	Female	.546	.417	1.717	1	.190	1.726	.763	3.906
	Race Not Specified	-.448	1.109	.163	1	.686	.639	.073	5.612
	White (Ref. Cat.)								
	African American	.861	1.091	.623	1	.430	2.366	.279	20.072
	Marital Status Not Specified	-18.114	17789.115	.000	1	.999	.000	.000	.
	Married (Ref. Cat.)								
	Widow	.041	.610	.005	1	.946	1.042	.315	3.447
	Divorced	-17.926	6751.226	.000	1	.998	.000	.000	.
	Single	-17.967	5462.854	.000	1	.997	.000	.000	.
	Separated	-17.155	17918.798	.000	1	.999	.000	.000	.
	Employment No (Ref. Cat.)								
	Full Time	.877	.734	1.429	1	.232	2.404	.571	10.128
	Part Time	.611	.657	.864	1	.352	1.842	.508	6.678
	Alcohol Consumption	.425	.410	1.072	1	.300	1.529	.684	3.417
	Tobacco Use No (Ref. Cat.)								
	Tobacco Use Yes	.495	.817	.366	1	.545	1.640	.330	8.142
	Tobacco Use Former	.604	.438	1.900	1	.168	1.829	.775	4.314
	Physical Activity	.134	.394	.116	1	.734	1.143	.528	2.474
	Charlson Index	-.060	.159	.143	1	.706	.942	.690	1.286
	(Constant)	30.078	12548.138	.000	1	.998	11550603469160.48		

a. Variable(s) entered on step 1: Inpatient Setting, 2009, 2010, 2011, 2012, 2013, Right Knee, Both Knees, Zimmer Zuk, Age, Female, Race Not Specified, African American, Marital Not Specified, Widow, Divorced, Single, Separated, Full Time, Part Time, Alcohol Consumption, Tobacco Use Yes, Tobacco Use Former, Physical Activity, Charlson Index.

Post-Operative Complications

Post-Operative Complications Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	24.135	25	.512
	Block	24.135	25	.512
	Model	24.135	25	.512

Post-Operative Complications Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	594.558[a]	.022	.051

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Post-Operative Complications Classification

Observed			Predicted		
			Post-Operative Complications		Percentage Correct
			No	Yes	
Step 1	Post-Operative Complications	No	985	0	100.0
		Yes	90	0	.0
	Overall Percentage				91.6

a. The cut value is .500

Post-Operative Complications Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	95% C.I.for EXP(B) Upper
Step 1[a]	Inpatient Setting (1)	.443	.270	2.690	1	.101	1.558	.917	2.646
	2009	.118	1.072	.012	1	.913	1.125	.138	9.196
	2010	-.337	.786	.184	1	.668	.714	.153	3.333
	2011	.375	.376	.991	1	.320	1.454	.696	3.041
	2012	.099	.333	.088	1	.766	1.104	.575	2.121
	2013	-.229	.321	.508	1	.476	.795	.424	1.492
	2014 (Ref. Cat.)								
	Left Knee (Ref. Cat.)								
	Right Knee	-.310	.227	1.861	1	.173	.734	.470	1.145
	Both Knees	-19.200	23107.089	.000	1	.999	.000	.000	.
	Zimmer Zuk	-.477	.965	.245	1	.621	.621	.094	4.111
	Age	-.011	.017	.423	1	.515	.989	.956	1.023

	Female	.142	.240	.350	1	.554	1.153	.720	1.845
	Race Not Specified	-.919	.756	1.477	1	.224	.399	.091	1.756
	White (Ref. Cat.)								
	African American	1.246	.518	5.782	1	.016	3.476	1.259	9.594
	Marital Status Not Specified	-18.425	17888.469	.000	1	.999	.000	.000	.
	Married (Ref. Cat.)								
	Widow	-.044	.383	.013	1	.909	.957	.452	2.026
	Divorced	-.492	.755	.424	1	.515	.612	.139	2.688
	Single	-.735	.635	1.339	1	.247	.479	.138	1.665
	Separated	-18.838	20022.289	.000	1	.999	.000	.000	.
	Employment No (Ref. Cat.)								
	Full Time	.309	.439	.496	1	.481	1.362	.576	3.221
	Part Time	.454	.379	1.438	1	.230	1.575	.750	3.310
	Alcohol Consumption	.009	.244	.001	1	.972	1.009	.625	1.628
	Tobacco Use No (Ref. Cat.)								
	Tobacco Use Yes	-.262	.552	.225	1	.635	.770	.261	2.270
	Tobacco Use Former	.014	.276	.002	1	.960	1.014	.590	1.742
	Physical Activity	-.256	.237	1.161	1	.281	.775	.487	1.233
	Charlson Index	-.056	.085	.429	1	.513	.946	.800	1.118
	(Constant)	-.601	2.270	.070	1	.791	.548		

a. Variable(s) entered on step 1: Inpatient Setting, 2009, 2010, 2011, 2012, 2013, Right Knee, Both Knees, Zimmer Zuk, Age, Female, Race Not Specified, African American, Marital Not Specified, Widow, Divorced, Single, Separated, Full Time, Part Time, Alcohol Consumption, Tobacco Use Yes, Tobacco Use Former, Physical Activity, Charlson Index.

Non-Surgery Related Complications

Non-Surgery Related Complications Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	40.900	25	.024
	Block	40.900	25	.024
	Model	40.900	25	.024

Non-Surgery Related Complications Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	719.656[a]	.037	.074

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Non-Surgery Related Complications Classification

Observed			Predicted: Non-Surgery Related Complications No	Predicted: Non-Surgery Related Complications Yes	Predicted: Percentage Correct
Step 1	Non-Surgery Related Complications	No	953	0	100.0
		Yes	121	1	.8
	Overall Percentage				88.7

a. The cut value is .500

Non-Surgery Related Complications Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	95% C.I.for EXP(B) Upper
Step 1[a]	Inpatient Setting (1)	.245	.232	1.118	1	.290	1.278	.811	2.014
	2009	-1.202	1.182	1.034	1	.309	.301	.030	3.048
	2010	-1.290	1.045	1.523	1	.217	.275	.035	2.136
	2011	.205	.356	.333	1	.564	1.228	.611	2.466
	2012	.043	.317	.018	1	.893	1.044	.561	1.942
	2013	.129	.270	.228	1	.633	1.138	.670	1.933
	2014 (Ref. Cat.)								
	Left Knee (Ref. Cat.)								
	Right Knee	.172	.200	.742	1	.389	1.188	.803	1.757
	Both Knees	-18.903	22704.113	.000	1	.999	.000	.000	.
	Zimmer Zuk	-1.852	1.113	2.767	1	.096	.157	.018	1.391
	Age	-.007	.015	.192	1	.662	.994	.965	1.023
	Female	-.157	.212	.550	1	.458	.855	.564	1.295
	Race Not Specified	-.358	.508	.498	1	.480	.699	.258	1.890
	White (Ref. Cat.)								
	African American	.207	.656	.099	1	.753	1.229	.340	4.448
	Marital Status Not Specified	.701	1.183	.351	1	.553	2.016	.199	20.473
	Married (Ref. Cat.)								
	Widow	-.194	.347	.314	1	.575	.823	.417	1.625
	Divorced	.165	.565	.085	1	.771	1.179	.390	3.567
	Single	1.018	.389	6.845	1	.009	2.768	1.291	5.934
	Separated	-18.802	18206.356	.000	1	.999	.000	.000	.

	Employment No (Ref. Cat.)								
	Full Time	-1.766	.643	7.551	1	.006	.171	.049	.603
	Part Time	-.569	.448	1.612	1	.204	.566	.235	1.363
	Alcohol Consumption	-.050	.214	.055	1	.815	.951	.626	1.446
	Tobacco Use No (Ref. Cat.)								
	Tobacco Use Yes	.745	.393	3.598	1	.058	2.107	.975	4.552
	Tobacco Use Former	.630	.225	7.811	1	.005	1.878	1.207	2.921
	Physical Activity	-.205	.209	.962	1	.327	.814	.540	1.227
	Charlson Index	-.073	.074	.949	1	.330	.930	.804	1.076
	(Constant)	2.425	2.460	.972	1	.324	11.303		

a. Variable(s) entered on step 1: Inpatient Setting, 2009, 2010, 2011, 2012, 2013, Right Knee, Both Knees, Zimmer Zuk, Age, Female, Race Not Specified, African American, Marital Not Specified, Widow, Divorced, Single, Separated, Full Time, Part Time, Alcohol Consumption, Tobacco Use Yes, Tobacco Use Former, Physical Activity, Charlson Index.

Deep Vein Thrombosis/Pulmonary Embolism

Deep Vein Thrombosis/Pulmonary Embolism Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	30.764	25	.197
	Block	30.764	25	.197
	Model	30.764	25	.197

Deep Vein Thrombosis/Pulmonary Embolism Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	73.252[a]	.028	.306

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Deep Vein Thrombosis/Pulmonary Embolism Classification

Observed			Predicted: Deep Vein Thrombosis/Pulmonary Embolism No	Predicted: Deep Vein Thrombosis/Pulmonary Embolism Yes	Predicted: Percentage Correct
Step 1	Deep Vein Thrombosis/ Pulmonary Embolism	No	1066	0	100.0
		Yes	9	0	.0
	Overall Percentage				99.2

a. The cut value is .500

Deep Vein Thrombosis/Pulmonary Embolism Variables in the Equation

								95% C.I.for EXP(B)	
		B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	**Lower**	**Upper**
Step 1[a]	Inpatient Setting (1)	-.349	.905	.149	1	.700	.705	.120	4.157
	2009	-13.965	8382.107	.000	1	.999	.000	.000	.
	2010	-14.705	5283.900	.000	1	.998	.000	.000	.
	2011	2.934	1.345	4.763	1	.029	18.808	1.349	262.316
	2012	2.139	1.250	2.927	1	.087	8.489	.732	98.389
	2013	.779	1.361	.328	1	.567	2.179	.151	31.366
	2014 (Ref. Cat.)								
	Left Knee (Ref. Cat.)								
	Right Knee	-.218	.721	.091	1	.762	.804	.196	3.302
	Both Knees	-14.089	19867.296	.000	1	.999	.000	.000	.
	Zimmer Zuk	-.445	7651.302	.000	1	1.000	.641	.000	.
	Age	.033	.053	.377	1	.539	1.033	.931	1.147
	Female	.444	.779	.326	1	.568	1.560	.339	7.173
	Race Not Specified	-14.394	4282.542	.000	1	.997	.000	.000	.
	White (Ref. Cat.)								
	African American	2.409	1.652	2.127	1	.145	11.127	.437	283.504
	Marital Status Not Specified	.231	17344.843	.000	1	1.000	1.260	.000	.
	Married (Ref. Cat.)								
	Widow	.649	.980	.439	1	.508	1.914	.280	13.063
	Divorced	1.275	1.302	.959	1	.327	3.578	.279	45.889
	Single	-16.563	4490.035	.000	1	.997	.000	.000	.
	Separated	-11.961	14453.233	.000	1	.999	.000	.000	.
	Employment No (Ref. Cat.)								
	Full Time	1.055	1.271	.689	1	.406	2.872	.238	34.677
	Part Time	1.214	1.264	.921	1	.337	3.366	.282	40.112
	Alcohol Consumption	-16.587	1656.378	.000	1	.992	.000	.000	.
	Tobacco Use No (Ref. Cat.)								

	Tobacco Use Yes	-15.887	4128.076	.000	1	.997	.000	.000	.
	Tobacco Use Former	1.204	.797	2.279	1	.131	3.332	.698	15.893
	Physical Activity	-1.778	1.111	2.559	1	.110	.169	.019	1.492
	Charlson Index	-.415	.333	1.548	1	.213	.660	.344	1.270
	(Constant)	-5.155	15302.604	.000	1	1.000	.006		

a. Variable(s) entered on step 1: Inpatient Setting, 2009, 2010, 2011, 2012, 2013, Right Knee, Both Knees, Zimmer Zuk, Age, Female, Race Not Specified, African American, Marital Not Specified, Widow, Divorced, Single, Separated, Full Time, Part Time, Alcohol Consumption, Tobacco Use Yes, Tobacco Use Former, Physical Activity, Charlson Index.

Emergency Room Visits

Emergency Room Visits Omnibus Tests of Model Coefficients

		Chi-square	**df**	**Sig.**
Step 1	Step	31.825	25	.163
	Block	31.825	25	.163
	Model	31.825	25	.163

Emergency Room Visits Model Summary

Step	**-2 Log likelihood**	**Cox & Snell R Square**	**Nagelkerke R Square**
1	142.898[a]	.029	.194

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Emergency Room Visits Omnibus Classification

Observed			**Predicted**		
			Emergency Room Visits		**Percentage Correct**
			No	Yes	
Step 1	Emergency Room Visits	No	1058	0	100.0
		Yes	17	0	.0
	Overall Percentage				98.4

a. The cut value is .500

Emergency Room Visits Omnibus Variables in the Equation

		B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	**95% C.I.for EXP(B)**	
								Lower	**Upper**
Step 1[a]	Inpatient Setting (1)	.081	.646	.016	1	.900	1.085	.306	3.850
	2009	-34.897	7192.242	.000	1	.996	.000	.000	.

	2010	-16.142	5955.548	.000	1	.998	.000	.000	.
	2011	.569	.943	.365	1	.546	1.767	.279	11.207
	2012	1.006	.751	1.794	1	.180	2.736	.627	11.927
	2013	.481	.754	.407	1	.524	1.618	.369	7.090
	2014 (Ref. Cat.)								
	Left Knee (Ref. Cat.)								
	Right Knee	-.131	.531	.061	1	.805	.877	.310	2.483
	Both Knees	-16.082	22970.663	.000	1	.999	.000	.000	.
	Zimmer Zuk	-18.402	5955.548	.000	1	.998	.000	.000	.
	Age	.065	.040	2.605	1	.106	1.067	.986	1.155
	Female	1.077	.607	3.152	1	.076	2.937	.894	9.650
	Race Not Specified	.646	1.179	.300	1	.584	1.908	.189	19.224
	White (Ref. Cat.)								
	African American	-15.819	7488.272	.000	1	.998	.000	.000	.
	Marital Status Not Specified	-18.461	16348.021	.000	1	.999	.000	.000	.
	Married (Ref. Cat.)								
	Widow	-.351	.768	.209	1	.648	.704	.156	3.173
	Divorced	-16.797	6248.974	.000	1	.998	.000	.000	.
	Single	.555	1.126	.243	1	.622	1.742	.192	15.820
	Separated	-13.074	14997.763	.000	1	.999	.000	.000	.
	Employment No (Ref. Cat.)								
	Full Time	-16.279	3908.770	.000	1	.997	.000	.000	.
	Part Time	-.200	1.137	.031	1	.860	.819	.088	7.608
	Alcohol Consumption	-.044	.596	.005	1	.941	.957	.298	3.076
	Tobacco Use No (Ref. Cat.)								
	Tobacco Use Yes	2.488	.811	9.411	1	.002	12.036	2.456	58.994
	Tobacco Use Former	1.380	.583	5.605	1	.018	3.975	1.268	12.457
	Physical Activity	.070	.546	.016	1	.898	1.072	.368	3.126

		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
	Charlson Index	.080	.205	.150	1	.699	1.083	.724	1.619
	(Constant)	24.418	11911.097	.000	1	.998	40226163975.489		

a. Variable(s) entered on step 1: Inpatient Setting, 2009, 2010, 2011, 2012, 2013, Right Knee, Both Knees, Zimmer Zuk, Age, Female, Race Not Specified, African American, Marital Not Specified, Widow, Divorced, Single, Separated, Full Time, Part Time, Alcohol Consumption, Tobacco Use Yes, Tobacco Use Former, Physical Activity, Charlson Index.

Hospitalizations

Hospitalizations Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	21.400	25	.670
	Block	21.400	25	.670
	Model	21.400	25	.670

Hospitalizations Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	185.480[a]	.020	.113

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Hospitalizations Classification

Observed			Predicted		
			Hospitalizations		Percentage Correct
			No	Yes	
Step 1	Hospitalizations	No	1054	0	100.0
		Yes	21	0	.0
	Overall Percentage				98.0

a. The cut value is .500

Hospitalizations Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Inpatient Setting (1)	.025	.544	.002	1	.964	1.025	.353	2.977
	2009	-17.481	9421.600	.000	1	.999	.000	.000	.
	2010	-17.221	6142.892	.000	1	.998	.000	.000	.
	2011	.125	.780	.026	1	.873	1.133	.246	5.225
	2012	.208	.701	.088	1	.766	1.232	.312	4.867

	2013	.554	.590	.882	1	.348	1.741	.547	5.535
	2014 (Ref. Cat.)								
	Left Knee (Ref. Cat.)								
	Right Knee	-.967	.495	3.811	1	.051	.380	.144	1.004
	Both Knees	-17.395	22797.540	.000	1	.999	.000	.000	.
	Zimmer Zuk	-.103	8445.040	.000	1	1.000	.902	.000	.
	Age	.028	.034	.707	1	.401	1.029	.963	1.099
	Female	-.657	.500	1.728	1	.189	.518	.195	1.381
	Race Not Specified	.714	1.105	.418	1	.518	2.042	.234	17.800
	White (Ref. Cat.)								
	African American	.905	1.135	.636	1	.425	2.473	.267	22.895
	Marital Status Not Specified	-16.523	15843.220	.000	1	.999	.000	.000	.
	Married (Ref. Cat.)								
	Widow	.750	.659	1.295	1	.255	2.116	.582	7.694
	Divorced	.352	1.095	.103	1	.748	1.422	.166	12.172
	Single	.261	1.085	.058	1	.810	1.298	.155	10.892
	Separated	-15.252	16847.475	.000	1	.999	.000	.000	.
	Employment No (Ref. Cat.)								
	Full Time	-.179	1.148	.024	1	.876	.836	.088	7.925
	Part Time	.502	.794	.399	1	.527	1.652	.348	7.836
	Alcohol Consumption	.001	.487	.000	1	.998	1.001	.385	2.600
	Tobacco Use No (Ref. Cat.)								
	Tobacco Use Yes	-.229	1.083	.045	1	.833	.796	.095	6.647
	Tobacco Use Former	-.888	.672	1.749	1	.186	.411	.110	1.534
	Physical Activity	-.647	.511	1.604	1	.205	.524	.192	1.425
	Charlson Index	-.044	.177	.062	1	.804	.957	.676	1.354
	(Constant)	-4.040	16890.079	.000	1	1.000	.018		

a. Variable(s) entered on step 1: Inpatient Setting, 2009, 2010, 2011, 2012, 2013, Right Knee, Both Knees, Zimmer Zuk, Age, Female, Race Not Specified, African American, Marital Not Specified, Widow, Divorced, Single, Separated, Full Time, Part Time, Alcohol Consumption, Tobacco Use Yes, Tobacco Use Former, Physical Activity, Charlson Index.

Follow-Up Pain

Follow-Up Pain Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	45.579	25	.007
	Block	45.579	25	.007
	Model	45.579	25	.007

Follow-Up Pain Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	789.892[a]	.042	.077

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Follow-Up Pain Classification

Observed			Predicted		
			Follow-Up Pain		Percentage Correct
			No	Yes	
Step 1	Follow-Up Pain	No	933	2	99.8
		Yes	139	2	1.4
	Overall Percentage				86.9

a. The cut value is .500

Follow-Up Pain Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Inpatient Setting (1)	.276	.220	1.576	1	.209	1.318	.857	2.027
	2009	.627	.780	.647	1	.421	1.873	.406	8.642
	2010	.103	.593	.030	1	.862	1.108	.347	3.543
	2011	.478	.333	2.060	1	.151	1.612	.840	3.095
	2012	.179	.294	.369	1	.543	1.195	.672	2.126
	2013	.096	.268	.127	1	.721	1.100	.650	1.862
	2014 (Ref. Cat.)								
	Left Knee (Ref. Cat.)								
	Right Knee	-.018	.188	.009	1	.923	.982	.680	1.419
	Both Knees	-19.296	23117.999	.000	1	.999	.000	.000	.
	Zimmer Zuk	-.669	.690	.939	1	.333	.512	.132	1.982
	Age	-.020	.014	2.004	1	.157	.980	.953	1.008
	Female	.730	.205	12.677	1	.000	2.076	1.389	3.104
	Race Not Specified	-.502	.492	1.042	1	.307	.605	.231	1.587
	White (Ref. Cat.)								
	African American	1.035	.492	4.428	1	.035	2.816	1.074	7.385
	Marital Status Not Specified	.587	1.177	.249	1	.618	1.799	.179	18.083

	Married (Ref. Cat.)							
	Widow	-.454	.344	1.744	1	.187	.635	.324	1.246
	Divorced	.075	.520	.021	1	.886	1.078	.389	2.983
	Single	-.437	.454	.927	1	.336	.646	.265	1.572
	Separated	.230	1.286	.032	1	.858	1.258	.101	15.638
	Employment No (Ref. Cat.)								
	Full Time	-.259	.394	.433	1	.511	.772	.357	1.670
	Part Time	.489	.323	2.296	1	.130	1.630	.866	3.069
	Alcohol Consumption	-.224	.208	1.163	1	.281	.799	.532	1.201
	Tobacco Use No (Ref. Cat.)								
	Tobacco Use Yes	-.447	.499	.801	1	.371	.640	.240	1.702
	Tobacco Use Former	.429	.220	3.822	1	.051	1.536	.999	2.363
	Physical Activity	.001	.194	.000	1	.995	1.001	.685	1.463
	Charlson Index	-.039	.071	.309	1	.578	.961	.836	1.105
	(Constant)	-.437	1.692	.067	1	.796	.646		

a. Variable(s) entered on step 1: Inpatient Setting, 2009, 2010, 2011, 2012, 2013, Right Knee, Both Knees, Zimmer Zuk, Age, Female, Race Not Specified, African American, Marital Not Specified, Widow, Divorced, Single, Separated, Full Time, Part Time, Alcohol Consumption, Tobacco Use Yes, Tobacco Use Former, Physical Activity, Charlson Index.

Follow-Up Functional Range of Motion

Follow-Up Functional Range of Motion Omnibus Tests of Model Coefficients

		Chi-square	**df**	**Sig.**
Step 1	Step	51.977	25	.001
	Block	51.977	25	.001
	Model	51.977	25	.001

Follow-Up Functional Range of Motion Model Summary

Step	**-2 Log likelihood**	**Cox & Snell R Square**	**Nagelkerke R Square**
1	263.356[a]	.047	.186

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Follow-Up Functional Range of Motion Classification

Observed			**Predicted** Follow-Up Functional Range of Motion: **No**	**Yes**	**Percentage Correct**
Step	Follow-Up	No	1038	1	99.9

1	Functional Range of Motion	Yes	36	0	.0
	Overall Percentage				96.6

a. The cut value is .500

Follow-Up Functional Range of Motion Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Inpatient Setting (1)	.290	.445	.425	1	.515	1.336	.559	3.196
	2009	.892	8188.061	.000	1	1.000	2.441	.000	.
	2010	-17.174	5872.413	.000	1	.998	.000	.000	.
	2011	-.294	.809	.132	1	.716	.745	.153	3.640
	2012	.701	.487	2.074	1	.150	2.015	.777	5.231
	2013	.296	.480	.381	1	.537	1.345	.525	3.445
	2014 (Ref. Cat.)								
	Left Knee (Ref. Cat.)								
	Right Knee	-.099	.362	.075	1	.785	.906	.446	1.840
	Both Knees	-17.289	22966.391	.000	1	.999	.000	.000	.
	Zimmer Zuk	-.047	8188.060	.000	1	1.000	.954	.000	.
	Age	-.038	.028	1.894	1	.169	.962	.911	1.016
	Female	.819	.411	3.980	1	.046	2.268	1.015	5.072
	Race Not Specified	-17.645	5102.323	.000	1	.997	.000	.000	.
	White (Ref. Cat.)								
	African American	1.933	.655	8.711	1	.003	6.907	1.914	24.928
	Marital Status Not Specified	-15.411	15544.303	.000	1	.999	.000	.000	.
	Married (Ref. Cat.)								
	Widow	-.572	.781	.535	1	.464	.565	.122	2.611
	Divorced	.459	.806	.324	1	.569	1.582	.326	7.685
	Single	.565	.619	.834	1	.361	1.760	.523	5.925
	Separated	-15.218	16187.201	.000	1	.999	.000	.000	.
	Employment No (Ref. Cat.)								
	Full Time	.852	.581	2.151	1	.143	2.343	.751	7.312
	Part Time	.664	.576	1.331	1	.249	1.942	.629	6.001
	Alcohol Consumption	-1.320	.491	7.230	1	.007	.267	.102	.699

	Tobacco Use No (Ref. Cat.)								
	Tobacco Use Yes	-17.970	4614.213	.000	1	.997	.000	.000	.
	Tobacco Use Former	.542	.417	1.684	1	.194	1.719	.758	3.895
	Physical Activity	.636	.369	2.973	1	.085	1.890	.917	3.895
	Charlson Index	.127	.134	.902	1	.342	1.136	.873	1.477
	(Constant)	-3.412	16376.121	.000	1	1.000	.033		

a. Variable(s) entered on step 1: Inpatient Setting, 2009, 2010, 2011, 2012, 2013, Right Knee, Both Knees, Zimmer Zuk, Age, Female, Race Not Specified, African American, Marital Not Specified, Widow, Divorced, Single, Separated, Full Time, Part Time, Alcohol Consumption, Tobacco Use Yes, Tobacco Use Former, Physical Activity, Charlson Index.

Patient Satisfaction

Pleased with the Results of UKA

Pleased with the Results of UKA Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	48.525	25	.003
	Block	48.525	25	.003
	Model	48.525	25	.003

Pleased with the Results of UKA Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	744.340[a]	.044	.085

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Pleased with the Results of UKA Classification

Observed			Predicted		
			Pleased with the Results		Percentage Correct
			No	Yes	
Step 1	Pleased with the Results of UKA	No	3	127	2.3
		Yes	1	944	99.9
	Overall Percentage				88.1

a. The cut value is .500

Pleased with the Results of UKA Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)

								Lower	Upper
Step 1[a]	Inpatient Setting (1)	-.006	.227	.001	1	.979	.994	.638	1.550
	2009	-1.284	.776	2.734	1	.098	.277	.060	1.269
	2010	-.986	.485	4.134	1	.042	.373	.144	.965
	2011	-.347	.367	.896	1	.344	.707	.344	1.451
	2012	-1.201	.284	17.894	1	.000	.301	.172	.525
	2013	-.104	.300	.120	1	.729	.901	.501	1.622
	2014 (Ref. Cat.)								
	Left Knee (Ref. Cat.)								
	Right Knee	-.186	.195	.911	1	.340	.830	.567	1.216
	Both Knees	18.653	23138.280	.000	1	.999	126126247.591	.000	.
	Zimmer Zuk	-.605	.653	.858	1	.354	.546	.152	1.965
	Age	.022	.015	2.171	1	.141	1.022	.993	1.052
	Female	-.150	.208	.524	1	.469	.860	.573	1.293
	Race Not Specified	.045	.502	.008	1	.928	1.046	.391	2.798
	White (Ref. Cat.)								
	African American	-.313	.605	.268	1	.605	.731	.223	2.393
	Marital Status Not Specified	19.114	17908.417	.000	1	.999	200047039.792	.000	.
	Married (Ref. Cat.)								
	Widow	-.255	.319	.639	1	.424	.775	.414	1.449
	Divorced	-.923	.442	4.355	1	.037	.397	.167	.945
	Single	.450	.556	.654	1	.419	1.568	.527	4.663
	Separated	-3.141	1.211	6.725	1	.010	.043	.004	.464
	Employment No (Ref. Cat.)								
	Full Time	.538	.454	1.405	1	.236	1.712	.704	4.167
	Part Time	-.048	.371	.017	1	.896	.953	.461	1.970
	Alcohol Consumption	.174	.213	.664	1	.415	1.190	.783	1.807
	Tobacco Use No (Ref. Cat.)								
	Tobacco Use Yes	-.433	.387	1.252	1	.263	.648	.304	1.385
	Tobacco Use Former	.045	.247	.033	1	.857	1.046	.644	1.698
	Physical Activity	.163	.204	.635	1	.425	1.177	.789	1.755

	Charlson Index	-.091	.075	1.485	1	.223	.913	.789	1.057
	(Constant)	2.954	1.701	3.015	1	.082	19.186		

a. Variable(s) entered on step 1: Inpatient Setting, 2009, 2010, 2011, 2012, 2013, Right Knee, Both Knees, Zimmer Zuk, Age, Female, Race Not Specified, African American, Marital Not Specified, Widow, Divorced, Single, Separated, Full Time, Part Time, Alcohol Consumption, Tobacco Use Yes, Tobacco Use Former, Physical Activity, Charlson Index.

Visual Analog Scale for Patient Satisfaction

Visual Analog Scale for Patient Satisfaction Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	5078.368	5400	.999
Deviance	1936.212	5400	1.000

Link function: Logit.

Visual Analog Scale for Patient Satisfaction Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	1982.304			
Final	1950.311	31.993	20	.043

Link function: Logit.

Visual Analog Scale for Patient Satisfaction Test of Parallel Lines

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	1950.311			
General	1782.415[b]	167.896[c]	180	.732

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.
a. Link function: Logit.
b. The log-likelihood value cannot be further increased after maximum number of step-halving.
c. The Chi-Square statistic is computed based on the log-likelihood value of the last iteration of the general model. Validity of the test is uncertain.

Visual Analog Scale for Patient Satisfaction Variables in the Equation

Parameter		B	Std. Error	95% Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
				Lower Bound	Upper Bound	Wald Chi Square	df	Sig		Lower	Upper Bound
Threshold	[VAS=.0]	-2.192	.9325	-4.020	-.365	5.528	1	.019	.112	.018	.694
	[VAS=1.0]	-1.346	.9297	-3.168	.477	2.094	1	.148	.260	.042	1.611

	[VAS =2.0]	-.617	.9284	-2.437	1.202	.442	1	.506	.539	.087	3.328
	[VAS =3.0]	-.116	.9285	-1.935	1.704	.016	1	.901	.891	.144	5.497
	[VAS =4.0]	.306	.9296	-1.516	2.128	.108	1	.742	1.358	.220	8.398
	[VAS =5.0]	1.058	.9353	-.775	2.891	1.280	1	.258	2.881	.461	18.013
	[VAS =6.0]	1.665	.9456	-.188	3.518	3.100	1	.078	5.285	.828	33.719
	[VAS =7.0]	1.826	.9496	-.035	3.687	3.696	1	.055	6.207	.965	39.922
	[VAS =8.0]	2.431	.9723	.526	4.337	6.253	1	.012	11.375	1.692	76.488
	[VAS =9.0]	2.952	1.0058	.981	4.924	8.616	1	.003	19.154	2.667	137.535
Location	[Inpatient Setting=1.0]	-.628	.1844	-.990	-.267	11.599	1	.001	.534	.372	.766
	[Inpatient Setting=2.0]	0[a]	.	.	.	.	.	.	1	.	.
	2009	0[a]	.	.	.	.	.	.	1	.	.
	2010	0[a]	.	.	.	.	.	.	1	.	.
	2011	0[a]	.	.	.	.	.	.	1	.	.
	2012	0[a]	.	.	.	.	.	.	1	.	.
	2013	-.188	.1644	-.510	.134	1.309	1	.253	.829	.600	1.144
	2014 (Ref. Cat.)										
	Left Knee (Ref. Cat.)										
	Right Knee	.014	.1556	-.291	.319	.008	1	.929	1.014	.747	1.376
	Both Knees	-1.911	1.2736	-4.408	.585	2.252	1	.133	.148	.012	1.795
	Zimmer Zuk	0[a]	.	.	.	.	.	.	1	.	.
	Age	-.014	.0121	-.038	.010	1.289	1	.256	.986	.963	1.010
	Female	.211	.1666	-.116	.537	1.598	1	.206	1.235	.891	1.711
	Race Not Specified	-.724	.4946	-1.693	.245	2.143	1	.143	.485	.184	1.278
	White (Ref. Cat.)										
	African American	.418	.5311	-.623	1.459	.620	1	.431	1.519	.536	4.301
	Marital Not Specified	1.031	1.7761	-2.450	4.512	.337	1	.561	2.805	.086	91.145
	Married (Ref. Cat.)										
	Widow	-.045	.2513	-.538	.447	.032	1	.857	.956	.584	1.564
	Divorced	-.106	.4036	-.897	.685	.069	1	.793	.900	.408	1.984
	Single	.570	.3593	-.134	1.275	2.519	1	.112	1.769	.875	3.577
	Separated	-.061	1.8166	-3.621	3.500	.001	1	.973	.941	.027	33.111
	Employment No (Ref. Cat.)										
	Full Time	-.415	.3216	-1.046	.215	1.667	1	.197	.660	.351	1.240
	Part Time	.264	.3260	-.375	.902	.653	1	.419	1.301	.687	2.465
	Alcohol Consumption	.152	.1679	-.177	.481	.825	1	.364	1.165	.838	1.618
	Tobacco Use No (Ref. Cat.)										
	Tobacco Use Yes	.145	.3707	-.581	.872	.153	1	.696	1.156	.559	2.391
	Tobacco Use Former	.226	.1773	-.121	.574	1.628	1	.202	1.254	.886	1.775
	Physical Activity	-.109	.1646	-.432	.213	.441	1	.507	.897	.649	1.238
	Charlson Index	-.121	.0586	-.236	-.006	4.268	1	.039	.886	.790	.994
	(Scale)	1[b]									

Dependent Variable: Visual Analog Scale of Patient Satisfaction
Model: (Threshold), Inpatient Setting, 2009, 2010, 2011, 2012, 2013, Right Knee, Both Knees, Zimmer Zuk, Age, Female, Race Not Specified, African American, Marital Not Specified, Widow, Divorced, Single, Separated, Full Time, Part Time, Alcohol Consumption, Tobacco Use Yes, Tobacco Use Former, Physical Activity, Charlson Index
a. Set to zero because this parameter is redundant.
b. Fixed at the displayed value.

Patient Perception of Satisfaction

Patient Perception of Satisfaction Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	106.351	22	.000
	Block	106.351	22	.000
	Model	106.351	22	.000

Patient Perception of Satisfaction Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	912.276[a]	.125	.173

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Patient Perception of Satisfaction Classification

Observed			Predicted		
			Patient Perception of Satisfaction		Percentage Correct
			No	Yes	
Step 1	Patient Perception of Satisfaction	No	96	172	35.8
		Yes	70	460	86.8
	Overall Percentage				69.7

a. The cut value is .500

Patient Perception of Satisfaction Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Inpatient Setting(1)	.007	.192	.001	1	.972	1.007	.691	1.467
	2009								
	2010								
	2011	-.770	.733	1.103	1	.294	.463	.110	1.948
	2012	-1.153	.226	26.003	1	.000	.316	.203	.492
	2013	-1.705	.202	70.916	1	.000	.182	.122	.270
	2014 (Ref. Cat.)								

	Left Knee (Ref. Cat.)								
	Right Knee	-.316	.162	3.804	1	.051	.729	.530	1.002
	Both Knees	19.280	22835.407	.000	1	.999	236231958.311	.000	.
	Age	.006	.012	.245	1	.621	1.006	.982	1.031
	Female	.396	.173	5.220	1	.022	1.486	1.058	2.087
	Race Not Specified	.599	.600	.996	1	.318	1.820	.561	5.904
	White (Ref. Cat.)								
	African American	.816	.619	1.734	1	.188	2.261	.671	7.614
	Marital Not Specified	-.502	1.433	.123	1	.726	.605	.036	10.038
	Married (Ref. Cat.)								
	Widow	-.060	.275	.048	1	.827	.941	.549	1.615
	Divorced	.584	.448	1.702	1	.192	1.793	.746	4.312
	Single	-.027	.384	.005	1	.945	.974	.459	2.066
	Separated	20.064	40192.969	.000	1	1.000	516988115.974	.000	.
	Employment No (Ref. Cat.)								
	Full Time	-.006	.346	.000	1	.987	.995	.505	1.959
	Part Time	.531	.352	2.274	1	.132	1.701	.853	3.394
	Alcohol Consumption	.325	.178	3.341	1	.068	1.384	.977	1.962
	Tobacco Use No (Ref. Cat.)								
	Tobacco Use Yes	.614	.435	1.999	1	.157	1.849	.789	4.333
	Tobacco Use Former	-.238	.195	1.491	1	.222	.788	.538	1.155
	Physical Activity	.070	.169	.172	1	.678	1.073	.770	1.495
	Charlson Index	.045	.062	.513	1	.474	1.046	.925	1.181
	(Constant)	.268	.949	.080	1	.778	1.307		

a. Variable(s) entered on step 1: Inpatient Setting, 2011, 2012, 2013, Right Knee, Both Knees, Age, Female, Race Not Specified, African American, Marital Not Specified, Widow, Divorced, Single, Separated, Full Time, Part Time, Alcohol Consumption, Tobacco Use Yes, Tobacco Use Former, Physical Activity, Charlson Index.

APPENDIX I
COST ANALYSIS TABLE

	Outpatient UKA	**Inpatient UKA**	**Difference**	**Percentage Difference**
Gross Charges	**$26,500.00**	$33,408.89	$6,908.89	20.68%
Direct Costs	**$4,911.29**	$7,349.30	$2,438.01	33.17%
Revenue	$7,437.56	**$10,564.53**	$3,126.97	29.60%
Revenue - Costs	$2,526.27	$3,215.23	$688.96	21.42%

REFERENCES

Alexopoulos, E. (2010). Introduction to multivariate regression analysis. *Hippokratia*,*14* (Suppl 1), 23-28.

Averill, R. F., & Goldfield, N. I. (1993). Design of a prospective payment patient classification system for ambulatory care. *Health Care Financing Review*, *15*(1), 71.

Balotsky, E. R. (2005). Is It Resources, Habit or Both: Interpreting Twenty Years of Hospital Strategic Response to Prospective Payment. *Health Care Management Review*, *30*(4), 337-346.

Bazzoli, G., Shortell, S., Dubbs, N., Chan, C., & Kralovec, P. (1999). A taxonomy of health networks and systems: bringing order out of chaos. *Health Services Research,* 33(6), 1683-1717.

Beddhu, S., Bruns, F. J., Saul, M., Seddon, P., & Zeidel, M. L. (2000). A simple Comorbidity scale predicts clinical outcomes and costs in dialysis patients. *American Journal Of Medicine*, *108*(8), 609-613.

Berger, R., Kusuma, S., Sanders, S., Thill, E., & Sporer, S. (2009). The feasibility and perioperative complications of outpatient knee arthroplasty. *Clinical Orthopaedics & Related Research*, *467*(6), 1443-1449. doi:10.1007/s11999-009-0736-7

Bramesfeld, A., Wedegärtner, F., Elgeti, H., & Bisson, S. (2007). How does mental health care perform in respect to service users' expectations? Evaluating inpatient and outpatient care in Germany with the WHO responsiveness concept. *BMC Health Services Research*, *7*, 99-99.

Borus, T., & Thornhill, T. (2008). Unicompartmental knee arthroplasty. *The Journal Of The American Academy Of Orthopaedic Surgeons*, *16*(1), 9-18.

Browne, J., Jamieson, L., Lewsey, J., van der Meulen, J., Copley, L., & Black, N. (2008). Case-mix & patients' reports of outcome in independent sector treatment centres: comparison with NHS providers. *BMC Health Services Research, 8*, 1-7. doi: 10.1186/1472-6963-8-78

Carayon, P., Hundt, A. S., Alvarado, C. J., Springman, S. R., & Ayoub, P. (2006). Patient safety in outpatient surgery: the viewpoint of the healthcare providers. *Ergonomics*, *49*(5-6), 470-485.

Castells, X., Alonso, J., Miguel, C., Cristina, R., Francesc, C., & Josep, A. (2001). Outcomes and costs of outpatient and inpatient cataract surgery: a randomised clinical trial. *Journal Of Clinical Epidemiology*, *54*(1), 23-29.

Casto, A. B., & Forrestal, E. (2013). Principles of healthcare reimbursement, (4th ed.). Chicago IL: AHIMA.

Centers for Medicare & Medicaid Services. (n.d.). *Centers for Medicare & Medicaid Services*. Retrieved from

Charlson, M., Pompei, P., Ales, K., & MacKenzie, C. (1987). A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *Journal Of Chronic Diseases*, *40*(5), 373-383.

Charlson, M., Szatrowski, T. P., Peterson, J., & Gold, J. (1994). Validation of a combined comorbidity index.*Journal Of Clinical Epidemiology*, *47*(11), 1245-1251.

Chukmaitov, A. S., Menachemi, N., Brown, L. S., Saunders, C., & Brooks, R. G. (2008). A comparative study of quality outcomes in freestanding ambulatory surgery centers and hospital-based outpatient departments: 1997–2004. *Health Services Research*, *43*(5p1), 1485-1504. doi: 10.1111/j.1475-6773.2007.00809.x

Committee on Quality of Health Care in America, Institute of Medicine. (2001). Crossing the quality chasm: A new health system for the 21st century. Retrieved from http:// www.iom.edu/Object.File/ Master/27/184/Chasm-8pager.pdf.

Conner-Spady, B. L., Sanmartin, C., Johnston, G. H., McGurran, J. J., Kehler, M., & Noseworthy, T. W. (2011). The importance of patient expectations as a determinant of satisfaction with waiting times for hip and knee replacement surgery. *Health Policy*, *101*(3), 245-252. doi:10.1016/j.healthpol.2011.05.011

Contino, D. S. (2000). The ABCs of APCs. *Nursing Management*, *31*(10), 12-16.

Daabiss, M. (2011). American Society of Anaesthesiologists physical status classification. *Indian Journal Of Anaesthesia*, *55*(2), 111-115. doi:10.4103/0019-5049.79879

Dias-Santos, D., Ferrone, C. R., Zheng, H., Lillemoe, K. D., & Fernández-Del Castillo, C. (2015). The Charlson age comorbidity index predicts early mortality after surgery for pancreatic cancer. *Surgery*,*157*(5), 881-887. doi:10.1016/j.surg.2014.12.006

DiGioia III, A., Lorenz, H., Greenhouse, P. K., Bertoty, D. A., & Rocks, S. D. (2010). A patient-centered model to improve metrics without cost increase: viewing all care through the eyes of patients and families. *Journal Of Nursing Administration*, *40*(12), 540-546. doi:10.1097/NNA.0b013e3181fc1

Donabedian, A. (1980a). Explorations in quality assessment and monitoring. Ann Arbor, Mich.: *Health Administration Press.*

Donabedian, A. (1980b). The definition of quality and approaches to its assessment. Ann Arbor, *Mich.: Health Administration Press.*

Donabedian, A. (1981). Criteria, norms and standards of quality: what do they mean? [Article]. *American Journal of Public Health*, *71*(4), 409-412.

Donabedian, A. (2005). Evaluating the quality of medical care. 1966. *The Milbank Quarterly*, 83(4), 691-729.

Dlugacz, Y. D., & Stier, L. (2005). More quality bang for your healthcare buck. *Journal of Nursing Care Quality*, *20*(2), 174-181.

Duchman, K. R., Yubo, G., Pugely, A. J., Martin, C. T., & Callaghan, J. J. (2014). Differences in short-term complications between unicompartmental and total knee arthroplasty. *Journal Of Bone & Joint Surgery, American Volume*, *96*(16), 1387-1394.

EHR Incentive Programs (n.d.). Retrieved from http://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/index.html?redirect=/ehrincentiveprograms/

Eun-Hye, J., Sun-Young, R., Joong Bae, A., & Hye-Young, K. (2011). Economic and patient-reported outcomes of outpatient home-based versus inpatient hospital-based chemotherapy for patients with colorectal cancer. *Supportive Care In Cancer*, *19*(7), 971-978. doi:10.1007/s00520-010-0917-7

Fried, B. J. (1988). Power acquisition in a health care setting: an application of strategic contingencies theory. *Human Relations*, 41(12), 915-927.

Fulton, L. V., Lasdon, L. S., McDaniel, R. R., Jr., & Coppola, N. (2008). Including quality, access, and efficiency in healthcare cost models. *Hospital Topics*, *86*(4), 3-17.

Gamotis, P. B., Dearmon, V. C., Doolittle, N. O., & Price, S. C. (1988). Inpatient hospital setting vs outpatient satisfaction: a research study. *AORN Journal*, *47*(6), 1421.

Giff, G. A., & Crompvoets, J. (2008). Performance indicators a tool to support spatial data infrastructure assessment. *Computers, Environment & Urban Systems*, *32*(5), 365-376. doi: 10.1016/j.compenvurbsys.2008.08.001

Greenwood, R., & Miller, D. (2010). Tackling design anew: getting back to the heart of organizational theory. *Academy Of Management Perspectives*, *24*(4), 78-88. doi:10.5465/AMP.2010.55206386

Haack, D. (2010). Ambulante Chirurgie/stationsersetzende Leistungen. (German). [Article]. *Outpatient surgery/substitution of inpatient services. (English)*, *12*, 259-261. doi: 10.1007/s10039-009-1563-5

Hammer, M., & Champy, J. (1993). *Reengineering the corporation: a manifesto for business revolution*. New York, NY: HarperBusiness.

Hannan, M. T., & Freeman, J. (1984). Structural inertia and organizational change. *American Sociological Review*, 49(2), 149-164.

HCAHPS: Patients' Perspectives of Care Survey. (n.d.). Retrieved from http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/HospitalHCAHPS.html

Heesterbeek, P. (2011). Mind the gaps!. *Acta Orthopaedica*, *82*1-26.

doi:10.3109/17453674.2011.623578

HIPAA - General Information. (n.d.).*Centers for Medicare & Medicaid Services*. Retrieved from http://www.cms.gov/Regulations-and-Guidance/HIPAA-Administrative-Simplification/HIPAAGenInfo/index.html?redirect=/hipaageninfo/

Hospital Outpatient Quality Reporting Program. (n.d.). Retrieved from http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/HospitalOutpatientQualityReportingProgram.html

Hutcheson, G.D. & Moutinho, L., (2011). Ordinary least-squares regression. *The Sage Dictionary of Quantitative Management Research* (pp. 224-228). Los Angeles: SAGE.

Kastner, C., Armitage, J., Kimble, A., Rawal, J., Carter, P. G., & Venn, S. (2006). The Charlson comorbidity score: a superior comorbidity assessment tool for the prostate cancer multidisciplinary meeting.*Prostate Cancer & Prostatic Diseases*, *9*(3), 270-274. doi:10.1038/sj.pcan.4500889

Kepros, J. P., & Opreanu, R. C. (2009). A new model for health care delivery. [Article]. *BMC Health Services Research*, *9*, 1-5. doi: 10.1186/1472-6963-9-57

Kolisek, F., McGrath, M., Jessup, N., Monesmith, E., & Mont, M. (2009). Comparison of outpatient versus inpatient total knee arthroplasty. [Article].*Clinical Orthopaedics & Related Research, 467*(6), 1438-1442.

Krywulak, S. A., Mohtadi, N. G. H., Russell, M. L., & Sasyniuk, T. M. (2005). Patient satisfaction with inpatient hospital setting versus outpatient reconstruction of the anterior cruciate ligament: a randomized clinical trial. [Article]. *Canadian Journal of Surgery*, *48*(3), 201.

Kurtz, S., Ong, K., Lau, E., Mowat, F., & Halpern, M. (2007). Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. *The Journal Of Bone And Joint Surgery. American Volume*,*89*(4), 780-785.

Jamali, A., Scott, R., Rubash, H., & Freiberg, A. (2009). Unicompartmental knee arthroplasty: past, present, and future. *American Journal Of Orthopedics (Belle Mead, N.J.), 38*(1), 17-23.

Jimenez-Garcıa, R., Villanueva-Martınez, M., Fernandez-de-Las-Penas, C., Hernandez-Barrera, V., Rıos-Luna, A., Garrido, P., & ... Gil-de-Miguel, A. (2011). Trends in primary total hip arthroplasty in Spain from 2001 to 2008: evaluating changes in demographics, comorbidity, incidence rates, length of stay, costs and mortality. *BMC Musculoskeletal Disorders*, *12*43. doi:10.1186/1471-2474-12-43

Jordan, W. F. (1983). Capital Recovery Options: A Response and an Note on Changes Resulting from the Tax Equity and Fiscal Responsibility act of 1982 (TEFRA). *Journal Of The American Taxation Association*, *5*(1), 63.

Josephson, S., & Barnett, P. P. (2004). At the bedside. Nesiritide: practical approach and benefits in the outpatient setting. *Journal of Cardiovascular Nursing*, *19*(5), 358-363.

Lansingh, V. C., Carter, M. J., & Martens, M. (2007). Global cost-effectiveness of cataract surgery. *Ophthalmology*, *114*(9), 1670-1678.

Larsen, K., Hansen, T., Søballe, K., & Kehlet, H. (2012). Patient-reported outcome after fast-track knee arthroplasty. *Knee Surgery, Sports Traumatology, Arthroscopy*, *20*(6), 1128-1135.

Lee, S., Nardo, L., Kumar, D., Wyatt, C. R., Souza, R. B., Lynch, J., & ... Link, T. M. (2014). Scoring hip osteoarthritis with MRI (SHOMRI): A whole joint osteoarthritis evaluation system. *Journal Of Magnetic Resonance Imaging: JMRI*, doi:10.1002/jmri.24722

Legrand, D. J., Vaes B., Matheï, C., Adriaensen, W., Van Pottelbergh, G., Degryse, J.M. (2014). Muscle strength and physical performance as predictors of mortality, hospitalization, and disability in the oldest old. *Journal Of The American Geriatrics Society*, *62*(6), 1030-1038.

Levy, H. J., & Mashoof, A. A. (2000). Outpatient open Bankart repair. *American Journal of Sports Medicine, 28*(3), 377-379.

Liang, B. A., & Mackey, T. (2011). Quality and Safety in Medical Care: What Does the Future Hold? [Article]. *Archives of Pathology & Laboratory Medicine*, *135*(11), 1425-1431. doi:

10.5858/arpa.2011-0154-OA

Longenecker, J. G., & Pringle, C. D. (1978). The illusion of contingency theory as a general theory. *Academy Of Management Review, 3*(3), 679-683. doi:10.5465/AMR.1978.4305970

Luthans, F., & Stewart, T. I. (1977). A general contingency theory of management. *Academy Of Management Review, 2(2),* 181-195. doi:10.5465/AMR.1977.4409038

Martens, P., Akin, S.-M., Maud, H., & Mohsin, R. (2010). Is globalization healthy: a statistical indicator analysis of the impacts of globalization on health. *Globalization And Health, 6*, 16-16.

McMahon, J., & Perritt, G. W. (1973). Toward a Contingency Theory of Organizational Control. *Academy Of Management Journal*, *16*(4), 624-635. doi:10.2307/254695

Midttun, L., & Martinussen, P. (2005). Hospital waiting time in Norway: what is the role of organizational change?. *Scandinavian Journal Of Public Health*, *33*(6), 439-446.

Miller, G., & Whicker, M. L. (1999). *Handbook of research methods in public administration*. New York: M. Dekker.

Mintzberg, H., & Van der Heyden, L. (1999). Organigraphs: Drawing how companies really work. *Harvard Business Review, 77*(5), 87-94.

Miyagi, J., Funabashi, N., Suzuki, M., Asano, M., Kuriyama, T., Komuro, I., & Moriya, H. (2007). Predictive indicators of deep venous thrombosis and pulmonary arterial thromboembolism in 54 subjects after total knee arthroplasty using multislice computed tomography in Logistic Regression models. *International Journal Of Cardiology*, *119*(1), 90-94. doi:10.1016/j.ijcard.2006.07.056

Momohara, S., Kawakami, K., Iwamoto, T., Yano, K., Sakuma, Y., Hiroshima, R., & ... Ikari, K. (2011). Prosthetic joint infection after total hip or knee arthroplasty in rheumatoid arthritis patients treated with nonbiologic and biologic disease-modifying antirheumatic drugs. *Modern Rheumatology / The Japan Rheumatism Association*, *21*(5), 469-475. doi:10.1007/s10165-011-0423-x

Munnich, E. L., & Parente, S. T. (2014). Procedures take less time at ambulatory surgery centers, keeping costs down and ability to meet demand up. *Health Affairs*, *33*(5), 764-769. doi:10.1377/hlthaff.2013.1281

Nissen, M. E. (2000). An experiment to assess the performance of a redesign knowledge system. *Journal of Management Information Systems, 17*(3), 25-43.

Owens, D. K., Qaseem, A., Chou, R., & Shekelle, P. (2011). High-value, cost-conscious health care: concepts for clinicians to evaluate the benefits, harms, and costs of medical interventions. [Article]. *Annals of Internal Medicine, 154*(3), 174-W.158.

Paquette, I. M., Smink, D., & Finlayson, S. R. G. (2008). Outpatient cholecystectomy at hospitals versus freestanding ambulatory surgical centers. *Journal of the American College of Surgeons, 206*(2), 301-305. doi: 10.1016/j.jamcollsurg.2007.07.042

Partial knee replacement is option for some patients: patients find quick return to normal activity. (2008). *Same-Day Surgery, 32*(3), 34-36.

Pohlmann, J. T., & Leitner, D. W. (2003). A comparison of ordinary least squares and Logistic Regression. *Ohio Journal Of Science*, *103*(5), 118-125.

Preston, A. M., Chua, W., & Neu, D. (1997). The diagnosis-related group-prospective payment system and the problem of the government of rationing health care to the elderly. *Accounting, Organizations & Society, 22*(2), 147-164.

Provan, K. G., Fish, A., & Sydow, J. (2007). Interorganizational networks at the network level: a review of the empirical literature on whole networks. *Journal Of Management*, 33(3), 479-516.

Quality vs. Costs? A survey of healthcare purchasing habits and concerns. (2000). *hfm (Healthcare Financial Management), 54*(7), 68.

Quan, H., Li, B., Couris, C. M., Fushimi, K., Graham, P., Hider, P., & ... Sundararajan, V. (2011). Updating and validating the Charlson comorbidity index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. *American Journal Of*

Epidemiology, *173*(6), 676-682. doi:10.1093/aje/kwq433

Rahmanian, P. B., Kröner, A., Langebartels, G., Özel, O., Wippermann, J., & Wahlers, T. (2013). Impact of major non-cardiac complications on outcome following cardiac surgery procedures: Logistic Regression analysis in a very recent patient cohort. *Interactive Cardiovascular And Thoracic Surgery*,*17*(2), 319-326. doi:10.1093/icvts/ivt149

Rao, L., Mansingh, G., & Osei-Bryson, K. (2012). Building ontology based knowledge maps to assist business process re-engineering. *Decision Support Systems*, 52(3), 577-589. doi:10.1016/j.dss.2011.10.014

Read the Law. (n.d.). *United States Department of Health and Human Services*. Retrieved from

Reinhardt, U. E. (2006). The Pricing Of U.S. Hospital Services: Chaos Behind A Veil Of Secrecy. *Health Affairs*, *25*(1), 57-69. doi:10.1377/hlthaff.25.1.57

Robinson, J. (1997). . Medical Care Research And Review: MCRR, 54(1), 3-24

Ruef, M., Mendel, P., & Scott, W.R. (1998). An organizational field approach to resource environments in health care: comparing entries of hospitals and home health agencies in the San Francisco Bay Region. *Health Services Research*, *32*(6), 775-803.

Sample Size Calculator - Confidence Level, Confidence Interval, Sample Size, Population Size, Relevant Population - Creative Research Systems. (n.d.). Survey Software - Questionnaire Software - Electronic Survey Software - The Survey System. Retrieved from

Schechtman, E. (2002). Odds Ratio, Relative Risk, Absolute Risk Reduction, and the Number Needed to Treat—Which of These Should We Use?. *Value In Health (Wiley-Blackwell), 5*(5), 430.

Sedgwick, P. (2014). Relative risks versus odds ratios. *BMJ (Online), 348*

Shah, J. J. (2009). Quality and payment: the U.S. experience of typing inpatient hospital setting and outpatient casemix payments to quality measures and reporting. [Article]. *BMC Health Services Research, 9,* 1-2. doi: 10.1186/1472-6963-9-s1-a19

Shugarman, L. R., & Whitenhill, K. (2011). The affordable care act proposes new provisions to build a stronger continuum of care. [Article]. *Generations, 35*(1), 11-18.

Shwartz, M., & Lenard, M. L. (1994). Improving Economic Incentives in Hospital Prospective Payment Systems Through Equilibrium Pricing. *Management Science,40*(6), 774-787.

Singh, J., & Lewallen, D. (2013). Ipsilateral lower extremity joint involvement increases the risk of poor pain and function outcomes after hip or knee arthroplasty. *BMC Medicine, 11*144. doi:10.1186/1741-7015-11-144

Singh, J., & Lewallen, D. (2014). Predictors of pain medication use for arthroplasty pain after revision total knee arthroplasty. *Rheumatology (Oxford, England), 53*(10), 1752-1758. doi:10.1093/rheumatology/ket443

Stieber, J. R., Brown, K., Donald, G. D., & Cohen, J. D. (2005). Anterior cervical decompression and fusion with plate fixation as an outpatient procedure. [Article]. *Spine Journal, 5*(5), 503-507. doi: 10.1016/j.spinee.2005.01.011

Strobel, M. J. (2010). Arthroskopische Eingriffe am Kniegelenk. (German). [Article]. *Knee arthroscopy. (English), 12,* 78-85. doi: 10.1007/s10039-010-1601-3

Summers, N., Dawe, U., & Stewart, D. A. (2000). A comparison of inpatient hospital setting and outpatient ASCT. [Article]. *Bone Marrow Transplantation, 26*(4), 389.

Talbot, C. (2008). Performance Regimes—The Institutional Context of Performance Policies. *International Journal Of Public Administration,31*(14), 1569-1591. doi:10.1080/01900690802199437

The Future of U.S. Health Care: value = quality/cost. (2009). [Article]. *hfm (Healthcare Financial Management),* 22-25.

Tolomeo, C., Savrin, C., Heinzer, M., Bazzy-Asaad, A. (2009). Predictors of asthma-related pediatric emergency department visits and hospitalizations. *Journal Of Asthma, 46*(8), 829-834.

Vittinghoff, E., & McCulloch, C. (2007). Relaxing the rule of ten events per variable in logistic and Cox regression. *American Journal Of Epidemiology, 165*(6), 710-718.

Voiosu, A., Tanţău, A., Garbulet, C., Tanţău, M., Mateescu, B., Băicuş, C., & ... Voiosu, T. (2014). Factors affecting colonoscopy comfort and compliance: a questionnaire based multicenter study.*Romanian Journal Of Internal Medicine = Revue Roumaine De Médecine Interne, 52*(3), 151-157.

Walker, R. M., Damanpour, F., & Devece, C. A. (2011). Management innovation and organizational performance: the mediating effect of performance management. *Journal Of Public Administration Research & Theory, 21*(2), 367-386. doi:10.1093/jopart/muq043

Wan, T. (2003). *Analysis and Evaluation of Health Care Systems: An Integrated Approach to Managerial Decision Making*. Baltimore: Health Professions Press. (Original work published 1995)

Wang, C. (2010). Service quality, perceived value, corporate image, and customer loyalty in the context of varying levels of switching costs. *Psychology & Marketing, 27*(3), 252-262.

Welsh, F. (1995). Accounting for the transition from inpatient to outpatient surgery. *Physician Executive,21*(6), 16.

Westbrook, K. W., Babakus, E., & Grant, C. C. (2014). Measuring patient-perceived hospital service quality: validity and managerial usefulness of HCAHPS scales. *Health Marketing Quarterly, 31*(2), 97-114. doi:10.1080/07359683.2014.907114

Williams, D., O'Brien, S., Doran, E., Price, A., Beard, D., Murray, D., & Beverland, D. (2013). Early postoperative predictors of satisfaction following total knee arthroplasty. *The Knee, 20*(6), 442-446. doi:10.1016/j.knee.2013.05.011

Williams, J. (2010). The value equation. [Article]. *hfm (Healthcare Financial Management), 64*(11), 98-104.

Wu, C., Qu, X., Liu, F., Li, H., Mao, Y., & Zhu, Z. (2014). Risk factors for periprosthetic joint infection after total hip arthroplasty and total knee arthroplasty in Chinese patients. *Plos ONE,9*(4), 1-7. doi:10.1371/journal.pone.0095300

Yang, C., Chen, P., Hsu, C., Chang, S., & Lee, C. (2015). Validity of the Age-Adjusted Charlson Comorbidity Index on Clinical Outcomes for Patients with Nasopharyngeal Cancer Post Radiation Treatment: A 5-Year Nationwide Cohort Study. *Plos ONE*, *10*(1), 1-11. doi:10.1371/journal.pone.0117323

Zhao, Z., Wang, S., Ma, W., Kong, G., Zhang, S., Tang, Y., & Zhao, Y. (2014). Diabetes mellitus increases the incidence of deep vein thrombosis after total knee arthroplasty. *Archives Of Orthopaedic & Trauma Surgery*, *134*(1), 79-83. doi:10.1007/s00402-013-1894-3